THE UNIVERSITY *of* EDINBURGH

"An Investigation into Field Impairment Tests and an evaluation of their validity and reliability as clinical tests of drug-related impairment of driving ability"

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By

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DECLARATION.

I, Michael O'Keefe, declare –

a. This thesis has been composed by myself.

b. This thesis is the result of my own work and research except in respect of the statistical analysis, which was performed by Dr Linda Williams, Centre for Population Health Sciences, University of Edinburgh.

c. This work has not been submitted for any other degree or professional qualification.

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March 2013

This work is dedicated to my family.

To my parents, now deceased, who would be very proud that I have completed and submitted this academic work.

To my wife Roseanne who has given me unwavering support over the years, but particularly in these final few hectic months.

To my daughters Clare and Angela who have always shown an interest, and a genuine admiration for my stamina, in addition to my academic efforts.

Finally to my fellow students, particularly those like myself, who have not always found academic life straightforward, who have not achieved success easily, and have had to suffer disappointment – completion of this thesis is an indication that self-belief and persistence, determination and stamina, however not the least, the help and support of others, is the key to success - no matter the path we choose to follow.

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ABSTRACT.

Background:

Drug use among the driving population is a major hazard to road safety and has been the subject of widespread research worldwide. In an attempt to detect and appropriately prosecute "drug-drivers", the UK has made legislative changes and has introduced Field Impairment Tests (FIT) in the Railway and Transport Safety Act 2003. These FIT, which are identical to the Standardised Field Sobriety Tests (SFST), were devised in the USA in the 1970s to identify clinical signs of impairment due to alcohol intoxication, but were not designed or intended to identify drug-related driving impairment. Concerns have been expressed that FIT are too difficult for their stated function, and are also inappropriate tests, since although they have been validated for alcohol effects they have never been validated for the effects of drugs. This thesis has sought to clarify matters and has questioned the validity of FIT by testing two opposing hypotheses –

1) **FIT are reliable and valid tests of drug-related impairment to drive - and drug-free individuals perform well on all tests.**

2) **FIT are not reliable and valid tests of drug-related impairment to drive - and are too difficult for some groups of drug-free individuals to perform.**

Methods:

A questionnaire was designed and a postal survey was undertaken of 960 Forensic Medical Examiners (FMEs) who were asked to give their opinion on the Field Impairment Tests (FIT). The responses of the FMEs were analysed in detail (chapter 3). FIT were then carried out on three separate groups of 100 subjects in police custody who were all known to have used no drugs for a period of at least 8 hours prior to the testing process (chapter 4). Group A subjects were opiate dependent; Group B were subjects who received legally prescribed methadone; Group C individuals denied any form of drug use. All study groups were simultaneously examined using conventional psychomotor tests, and the results were compared using detailed statistical analysis with logistic regression and summative scores.

Results:

Returned FME questionnaires showed 63% of FMEs considered the tests "about right" but a significant number ($p<0.0001$) of 33% of FMEs stated FIT were "too difficult". The studies on subjects in custody clearly showed 82% of group A; 44% of group B; and 19% of group C were unable to complete FIT satisfactorily, although only 12% of group A; 2% of group B; and 3% of group C were unable to successfully perform conventional psychomotor and cognitive tests. These findings clearly supported the assertions held by 33% of FMEs surveyed that FIT were too difficult for their stated purpose and that poor performance in FIT could not be regarded as definitive evidence of drug-related impairment in driving ability.

Conclusions:

The results of the research studies conducted have provided very strong support in favour of **hypothesis 2**)

FIT are not reliable and valid tests of drug-related impairment to drive - and are too difficult for some groups of drug-free individuals to perform.

In an attempt to overcome the problems in respect of FIT, specific proposals have been offered including the introduction of a new battery of more relevant clinical tests of impairment (CTI); a change in the method and manner in which the proposed new tests are applied; and possible legislative and administrative measures which might be introduced to more appropriately and effectively tackle this on-going hazard to road safety.

LIST OF ABBREVIATIONS.

ACPO	Association of Chief Police Officers
AFP	Association of Forensic Physicians
ANS	Autonomic Nervous System
APS	Association of Police Surgeons
AS	Asperger's Syndrome
BAC	Blood alcohol concentration
BZP	1-benzylpiperazine
CNS	Central Nervous System
CRT	Choice reaction time
CTI	Clinical tests of impairment
CTI25	Clinical tests of impairment 25 Norwegian
CTT	Critical tracking task
DFM	Diploma Forensic Medicine
DfT	Department for Transport
DEC	Drug evaluation classification
DETR	Department of Environment Transport and the Regions
DMJ	Diploma Medical Jurisprudence
DPP	Director of Public Prosecutions
DRE	Drug recognition expert
DRUID	Driving under the influence of drugs, alcohol and medicines
DUI	Driving under the influence of alcohol
DUID	Driving under the influence of drugs
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction
FIT	Field Impairment Tests

FME	Forensic Medical Examiner
FP	Forensic Physician
FSS	Forensic Science Service
GCS	Glasgow Coma Scale
H2	Histamine 2
HGN	Horizontal gaze nystagmus
HMJ	Head movement jerks
ICADTS	International Council Alcohol Drugs and Traffic Safety
LSD	Lysergic acid diethylamide
MAOI	Mono-amine oxidase inhibitors
MDA	3,4-meyhylenedioxyamphetamine
MDEA	3,4-meyhylenedioxyethylamphetamine
MDMA	3,4-meyhylenedioxymethamphetamine
mg/l	Milligrams per litre
ng/ml	Nanograms per millilitre
NHTSA	National Highway Traffic Safety Administration
NIDA	National Institute on Drug Abuse
NPi™	Neurological Pupil index
NPV	Negative predictive value
OMT	Opioid maintenance treatment
OR	Odds ratio
PBT	Preliminary Breath Test
PDT	Preliminary Drug Test
PIT	Preliminary Impairment Test
PPV	Positive predictive value
ROAME	Rationale Objectives Appraisal Monitoring Evaluation

RTA	Road Traffic Act
SDLP	Standard Deviation Lateral Position
SFST	Standardised Field Sobriety Tests
SRT	Simple reaction time
SSRI	Selective serotonin re-uptake inhibitor
TCA	Tricyclic antidepressants
THC	Δ9-tetrahydrocannabinol
THC-COOH	11-nor- Δ9-THC-9 carboxylic acid
TRL	Transport Research Laboratory
VGN	Vertical gaze nystagmus

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CHAPTER 1. Introduction.

Drug use, both prescribed and illicit, within the general population is a cause for concern in the U.K. and throughout Europe (North 2010; EMCDDA 2011; EMCDDA 2012). Of particular concern is drug use within the driving population (Assum et al. 2005; Oliver et al. 2006; Officer 2009; Lacey 2010; EMCDDA 2012a). Department for Transport studies showed illicit drug use by drivers involved in fatal road traffic accidents had increased six-fold from 3% (1985-87) to 18% (1997-1999) DETR (1998; Tunbridge, Keigan and James 2001) and these studies clearly highlighted the risk to road safety posed by "drug-drivers".

It has long been acknowledged that there is no specific training for Forensic Medical Examiners (FMEs) called by police to examine suspect "drug-drivers" which would enable them to reliably diagnose evidence of drug-related impairment in driving ability. However in 1998 Strathclyde Police in Scotland awarded a research grant to two police officers to visit Los Angeles Police Department in California U.S.A. and study their methods of dealing with "drug-drivers". On their return, the officers produced a training package for police officers and police surgeons (Fleming and Stewart 1998), which introduced the Field Impairment Tests (FIT). These tests were the subject of a pilot study conducted by several police forces in the UK over a 15-month period from early 1999 to August 2000 prior to their introduction in the Railways and Transport Safety Act 2003. However following their demonstration to the FMEs, concerns were voiced by some FMEs that FIT were over-complicated tests, were difficult for "normal" people to perform and had not been validated by any independent researchers. These views echoed my own concerns regarding FIT and encouraged me to conduct my own research as detailed within the thesis.

1.1. Synopsis of the thesis.

This thesis investigates Field Impairment Tests (FIT) in relation to their current use as indicators of drug-related impairment of driving ability and questions their reliability and validity. This work is important because the findings recorded following use of FIT by police officers are led as evidence of drug-related impairment in driving ability by Crown prosecutors in courts of law throughout the United Kingdom. The work is particularly important because FIT has never been validated by any evidence-based research process and has simply been accepted as reliable by government legislators, legal representatives and court adjudicators. Groups affected by the current use of FIT include police personnel; forensic medical examiners (FMEs); legal participants in the court arena; however most importantly the suspect driver for whom the consequences of conviction are considerable.

This work is based on my personal experience of over 30 years working as an FME for Strathclyde Police which has involved my examination of drivers suspected to be under the influence of alcohol and/or drugs and of my subsequent involvement in the legal arena, as a witness both for the prosecution and the defence. The work involved in the production of the thesis started in 2002 and concluded in 2012.

The initial research studies of the thesis detailed in chapter 3 relate to postal surveys designed and conducted by myself and which involved a survey of FMEs who had attended a training session on the use of FIT; a postal survey of all FMEs employed by Strathclyde Police in Scotland; and finally a more detailed questionnaire postal survey of 960 FMEs throughout the United Kingdom. The purpose was to ascertain and evaluate the opinion of the FMEs regarding the suitability of FIT as a diagnostic indicator of drug-related impairment of driving ability.

The major research projects of the thesis fully explained in chapter 4 are independent of the postal surveys although the responses of the FMEs surveyed provided the stimulus for this further work. These studies investigated the findings following controlled application of FIT to three separate core groups, each of 100 subjects who were specially selected and known to have used no drugs for a period of at least 8 hours prior to the clinical assessment.

The results of the postal surveys of the FMEs indicated that whilst the majority of FMEs considered FIT acceptable or "about right" the majority also felt that at least one test in FIT was too difficult. However it was also clearly evident that a significant percentage of the FMEs considered FIT too difficult and unacceptable.

The research studies conducted revealed that a high percentage of drug-free subjects were unable to complete FIT satisfactorily and this supported the assertions held by a significant percentage of FMEs surveyed that poor performance in FIT could not be regarded as definitive evidence of impairment in driving ability due directly to drugs.

This work is both original and unique since although FIT has been evaluated in subjects given controlled doses of central nervous system (CNS) active drugs, FIT has never been evaluated in a controlled drug-free population.

This research is vital since it is essential to understand how a drug-free or "normal" population will perform when subjected to FIT; and the findings of this research which are evidence-based, add significantly to the knowledge base of this complex and not yet fully understood subject.

1.2. Epidemiology of "drugs and driving".

Methodology: In order to study the available evidence in relation to driving whilst under the influence of drugs, I conducted a comprehensive literature search involving the following databases Pubmed; Medline Plus; Cochrane Library; Embase; Scirus; Scopus; SpringerLink and search terms, initially "drugs and driving" initially in 2004. Subsequent to this date I monitored published literature on the same databases and collected additional references relevant to the research topic. Only peer reviewed articles from scientific journals plus official databases from the Department for Transport and the National Highway Traffic Safeway Administration were considered.

Reliable data relating to the problem of "drugs and driving" is available from the U.K., member countries of the European Union, the U.S.A., Canada, and Australia (de Gier 2000; Longo et al. 2000; Fitzpatrick, Daly, Leavy and Cusack 2006; Normann et al 2007; EMCDDA 2008; EMCDDA 2009; Lacey 2010; North 2010a; North 2010b DRUID 2012). However despite the availability of such evidence there is a lack of routine in the collection, extraction and analysis of the data such that a clear picture has failed to emerge (Wolff 2013). The term "drugs and driving" is used routinely by international advisory bodies including the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA); International Council on Alcohol Drugs and Traffic Safety (ICADTS); Driving Under the Influence of Drugs, Alcohol and medicines (DRUID), all of which are concerned principally with illegal drugs of abuse and some prescription drugs with abuse potential. This thesis shall consider the problem of drug-related impairment of driving ability from the same perspective.

Drug use, both medicinal and illicit, is increasing within the general population and it has been clearly shown that drug use is also increasing within the driving population (Assum et al. 2005; Oliver et al. 2006; Officer 2009; Owens and Ramaekers 2009). Research evidence clearly indicates that driving while under the influence of illegal drugs regularly occurs and approaches levels of driving under the influence of alcohol among younger drivers (Krueger 1995; Augsburger and Rivier 1997; Seymour and Oliver 1999; Morland 2000; Seymour and Oliver 2000; Smink, Ruiter, Lusthof, and Zweipfennig, 2001; Drummer et al. 2003; Jones et al. 2003; Walsh et al. 2004; EMCDDA 2008; EMCDDA 2009 and Officer 2009).

The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) reported drug use in drivers throughout Europe to be in the region of 1% to 5% for illicit drugs, and 5% to 15% for licit drugs EMCDDA (2007). However the research database remains incomplete and has not facilitated the implementation of policies and legislation directed towards the problem (Gust 2007; North 2010; Wolff 2013).

Some drugs commonly detected in drivers are thought to impair the safe driving ability of those taking them, although there is lack of consensus in the numerous research papers on the subject as to how such impairment is caused and how serious it actually is (McKetin et al. 1999; O'Neill et al 2000; Comer et al. 2001; Fishbain et al. 2003; Drummer et al. 2004; Silber et al. 2005; Bramness et al. 2006; and Ramaekers et al. 2006).

Kemppainnen (2009) reported around 39,000 people were killed on Europe's roads and almost two million injured in traffic accidents in 2008 and approximately 25 % of these road fatalities were caused by “impaired” drivers. EMCDDA (2009) reports approximately 20 million Europeans have used cannabis during the previous year. Of these 9.5 million were classified as “current users” and approximately 3 million young adults were estimated to be daily users. In the case of cocaine, 3.5 million people admitted previous and 1.5 million were current or daily users.

The use of prescribed medication by drivers is also a concern in respect of road safety (de Gier 1998; de Gier 2000; Tunbridge and Rowe 2000; Normann et al 2007). However it remains unclear whether road traffic collisions in this group of drivers occur as a direct result of medicinal drug consumption in itself, or whether these incidents should be linked to the underlying condition for which the drug was prescribed (Skegg 1979; Greenblatt and Shader 1992; Sherwood 1998; and Brunnauer and Laux 2010). Indeed it has been reported (Hobi et al. 1982) that depressive illnesses can result in impairment of driving ability and that depressed patients whose conditions have responded to appropriate medications may show a clear improvement in driving as a direct result of the effect of their treatment. This view has been supported (Greenblatt and Shader 1992) and more recently by Wingen et al. (2005; Berghaus and Hilgers 2009; and Brunnauer and Laux 2010) who have suggested that in the patient whose condition has an adverse effect on their driving ability, the benefits of treatment in respect of improved alertness, concentration, and attention can compensate for any detrimental side effects of drug therapy.

1.3. Illegal drugs and driving.

The drugs of most importance to the problem of drugs and driving include -

- **Cannabis**
- **Opiates**
- **Cocaine** and "crack" cocaine
- **Amphetamines; Designer Amphetamines; Methamphetamine & MDMA**
- **Ketamine**
- **Hallucinogens** such as LSD

1.3.1. Cannabis:

Cannabis is the collective term for the psycho-active substances of the cannabis sativa plant and is one of the most abused illicit drugs world-wide. Cannabis products are mostly smoked in combination with tobacco by way of a "joint"; they can also be ingested in preparations such as tea or cake; however the effect of the THC is much higher after smoking than after ingestion.

Epidemiology: Cannabis use is widespread in drivers throughout Europe, North America and Australia (Mason and McBay 1984; Everest, Tunbridge and Widdop 1988; Soderstrom et al. 1988; Terhune at al. 1992; Gjerde, Beylich and Morland 1993; Drummer 1994; Drummer 1995; Logan and Schwilke 1996; Tomaszewski et al. 1996; Augsburger and Rivier 1997; de Gier 1998; Hildegard and Berghaus 1998; Marquet et al. 1998; Schepens et al. 1998; Dussault, Lemire, Bouchard and Brault 2000; Longo et al 2000 and 2000a; Swann 2000; Tunbridge and Rowe 2000; Walsh, Cangianelli, Buchan and Leaverton 2000; Brault et al. 2004; Logan and Schwilke

2004; Ramaekers, Berghaus, van Laar and Drummer 2004; Laumon et al. 2005; Walsh et al. 2005; Fitzpatrick, Daly, Leavy and Cusack 2006; Mura et al. 2006; EMCDDA Insights 2008f; EMCDDA Insights 2008g; Drummer 2009; Drummer 2009a; Hingson 2010; Lacey 2010).

General effects and clinical signs: Classical clinical signs of cannabis use are tachycardia (increased heart rate), and hypertension (increased blood pressure from normal range). Moderate hyperthermia (increase in body temperature) is frequently but not always detected. The only regularly detected abnormality of the eyes is a lack of convergence, since nystagmus, either vertical or horizontal, is not a definitive or diagnostic feature of cannabis alone. Change in pupil size is not directly related to cannabis use since it has been demonstrated that pupil reaction in volunteers varied depending upon the dosage and type of cannabis smoked (Stark et al 2003). The most commonly reported effects are – a feeling of calmness, well-being and drowsiness, with euphoria; increased sociability, friendliness and happiness; altered perception of time and place; changes in visual and auditory perception, frequently with hallucinations; short term memory loss; and decreased psychomotor abilities.

Psychomotor effects:

Cannabis has been shown for many years to have a direct effect in the immediate post-dose phase, producing significant decrements in psychomotor and cognitive skills considered necessary for safe completion of the driving task (Moskowitz 1984;

Heishman, Huestis, Henningfield and Cone 1990; Robbe and O'Hanlon 1993; Chait and Perry 1994; Robbe 1998; Hindrik, Robbe and O'Hanlon 1999; Compton, Shinar and Schechman 2000; Sexton et al. 2000; Hart et al. 2001; Liguori et al. 2002; Couper et al. 2004; Ilan et al. 2004; Nicholson et al. 2004; Tunbridge 2004; Papafoitiou, Carter and Stough 2005; Ramaekers et al. 2006; Ramaekers et al. 2006a; Ramaekers 2007; Bosker et al 2012; Downey et al. 2012; Schwope, et al. 2012).

Various studies on simulators and actual on-road driving have clearly indicated that cannabis is directly related to performance decrements relating to time and distance estimation, sustained vigilance, motor co-ordination, reaction times and tracking ability (Hart et al. 2001; Ilan et al. 2004; Sexton et al. 2000; Liguori et al. 2002; Nicholson et al. 2004; Ramaekers et al. 2006).

There can be no doubt that the effect of cannabis on perception, cognitive functions, psychomotor performance, co-ordination, tracking, vigilance and alertness are all affected to the extent that cannabis use is not compatible with safe driving.

1.3.2. Opiates – morphine and heroin.

Opium is the dried milky exudate of the unripe capsules of Papaverum somniferum and contains between 4% and 21% of morphine. Heroin (diacetyl morphine) is synthesised from morphine by double acetylation.

Epidemiology: A strong body of evidence points to widespread use of opiates by drivers (Gjerde, Beylich and Morland 1993; Tomaszewski et al. 1996; De Gier 1998; Hildegard and Berghaus 1998; Marquet et al. 1998; Schepens et al. 1998; Brault et al. 2004; Logan and Schwilke 2004; Laumon et al. 2005; Hingson 2010).

General effects and clinical signs: Heroin used intravenously generally results an intense warm feeling or flushing accompanied by a surge of euphoria frequently likened to an orgasm commonly called a "rush", followed by a period of intermittent sedation and drowsiness resulting in a state of narcosis with grossly impaired cognitive awareness and function.

The psychological effects claimed are a feeling of well-being and relaxation, however these are accompanied by extreme lethargy, and drowsiness, sedation, leading to extreme impairment of cognitive awareness and function.

The standard physiological effects are central nervous system (CNS) depression, nausea and vomiting, reduced gastrointestinal motility, constipation, muscle cramps, fixed constricted pupils, diminished reflexes, and depressed consciousness, depressed heart rate, and respiratory depression.

Psychomotor effects: Laboratory studies have revealed heroin produces subjective feelings of sedation for up to 5-6 hours with apathy and indifference to external stimuli, poor concentration and delayed reaction time. In several case reports, where the subjects tested positive for morphine and/or 6-acetylmorphine, observations included slow driving, weaving, poor vehicle control, poor coordination, slow response to stimuli, delayed reactions, difficultly in following instructions, and falling asleep at the wheel (Couper et al. 2004; Huestis and Smith 2009a). However

it has been noted in some cases that some opioid dependent subjects perform better on driving tests after receiving the opioids (Galski, Williams and Ehle 2000; Fishbain et al. 2003; Stout and Farrell 2003). It is noteworthy that no experimental studies on the acute effects of heroin in humans have been published since 1999 (EMCDDA Insights 2008b).

1.3.3. Cocaine.

Cocaine is extracted from the leaves of the coca plant. The base is smoked while the hydrochloride is snorted intra-nasally.

Epidemiology: Cocaine is less frequently used than cannabis and opiates in drivers but is by no means uncommon (Budd, Muto and Wong 1989; Tomaszewski et al 1996; Marquet et al. 1998; Del Rio and Alvarez 2000; Brault et al. 2004; Logan and Schwilke 2004; Laumon et al. 2005; Hingson 2010; Lacey 2010).

General effects and clinical signs: Users claim feelings of generalised well-being, coupled with a degree of excitement including sexual arousal, and occasional euphoria, with elimination of fatigue and enhanced energy. Less welcome sequelae are restlessness, anxiety, tremors, and irritability. Clinical evidence of cocaine effect is found in dilated pupils, increased blood pressure and heart rate and, increased body temperature (Couper et al. 2004). Observers have noted an increase in simple attention and alertness with improvement in simple reaction time although memory and higher cognitive functions were not improved by cocaine use (Rush et al. 1999).

Psychomotor effects: The acute adverse effects include increased driving speed and lack of smooth vehicle control; with potential risk taking procedures being the result of the stimulant phase of the drug, which may lead to increased risk taking. Although Hopper et al. (2004) found no effect of a low dose of cocaine on measures of recall or recognition task performance it is acknowledged chronic use of cocaine can lead to cognitive defects, impaired psychomotor performance and impulsive behaviour (EMCDDA Insights 2008 c).

1.3.4. Amphetamine; Methamphetamine and "Ecstasy" (MDMA).

Amphetamine is a CNS stimulant drug, which is rarely prescribed although, has a legitimate role to play in the treatment of conditions such as narcolepsy, and attention deficit hyperactivity disorder in children. Designer amphetamines include methamphetamine (MDA) which is a stimulant and hallucinogen drug with effects similar to those of cocaine, whereas "ecstasy" 3,4 Methylenedioxymethamphetamine (MDMA) has similar effects with the addition of a psychedelic element.

Epidemiology: These drugs are not uncommonly reported in drivers (Christophersen, Bjorneboe and Gjerde 1990; Terhune et al. 1992; Gjerde, Beylich and Morland 1993; Logan 1996; de Gier 1998; Marquet et al. 1998; Schepens et al. 1998; Walsh, Cangianelli, Buchan and Leaverton 2000; Logan and Schwilke 2004; Laumon et al. 2005; Hingson 2010).

General effects and clinical signs: One of the main effects on the central nervous system is the resultant increased alertness and elevation of mood frequently resulting in a sense of euphoria which may last for several hours and reduction in fatigue which is the basis for treatment of narcolepsy. Physiological signs of use include increased heart rate bounding pulse and dilated pupils. The major psychological adverse effects are psychotic states including paranoid episodes, which are associated with repeated high dose binge episodes.

Psychomotor effects: Laboratory studies of **amphetamine** on healthy non-fatigued volunteers have produced variable results (McKetin et al. 1999; Asghar et al. 2003; Silber et al. 2006). Studies on sleep-deprived subjects are similarly unclear (EMCDDA Insights 2008d). Mills et al. (2001) reported no improvement in performance with low dose amphetamine (10mg) however Wesensten et al. (2005) noted the effects on executive function tasks were mixed with improvements in some tasks and decrements in others. Drivers under the influence of amphetamines are known to drive erratically, have difficulty in maintaining appropriate speed and lane control, exhibit lack of caution in their mode of driving resulting in increased risk taking manoeuvres, and also may exhibit diminished alertness due to overwhelming fatigue in periods of abstinence (Huestis and Smith 2009; Huestis 2010).

Studies of low dose **methamphetamine** (5 or 10 mg) given to healthy volunteers (Comer et al. 2001) have reported no performance decrements in cognitive or psychomotor functions however when higher doses were given, (Johnson et al. 2000; Silber et al. 2006) an improvement in attention, tracking ability and perceptual speed

was reported. Logan (1996) conducted a review conducted a retrospective review of drivers arrested or killed in road traffic accidents and who had tested positive for methamphetamine. He noted in this group of drivers speeding, erratic driving with poor control of lane travel, agitation, disorientation, impulsive or irrational and aggressive behaviour and concluded "*Methamphetamine at any concentration is likely to produce symptoms that are inconsistent with safe driving."*

Studies in respect of **"ecstasy"** 3,4 Methylenedioxymethamphetamine (**MDMA**) indicate increased impulsivity and decrements in attention during complex tasks (Lamers et al. 2003). Laboratory studies have demonstrated changes in cognitive, perception and mental associations, instability, uncoordinated gait, and poor memory recall. Distortion of perception, thinking, and memory, impaired tracking ability, disorientation to time and place, and slow reactions are also known performance effects (Smith et al. 2006; Kuypers, Samyn and Ramaekers 2006; Ramaekers, Kuypers and Samyn 2006). Single oral doses of MDMA are reported to cause subjective excitability, anxiety, perceptual changes, and thought disorders 1 to 3 hours post dosage (Couper at al. 2004). Regular users of MDMA were assessed (de Waard et al. 2000) in an advanced driving simulator study immediately after ingestion of MDMA, later in the night and also on a night when they had not taken MDMA. The subjects were noted to drive faster and had increased variance in speed although their lane control and vehicle tracking was not adversely affected. Ramaekers et al. (2006) conducted a double blind crossover study on 18 recreational MDMA users in "on the road" driving tests and reported MDMA significantly decreased SDLP and decreased performance in the car-tracking test.

1.3.5. Ketamine.

Ketamine is a synthetic CNS sedative mainly used as a veterinary anesthetic and is reported to produce a dream-like effect although an hallucinogenic state may also be experienced, with a degree of amnesia also reported.

Epidemiology: Less research studies have been conducted in relation to ketamine use by drivers however (Cheng et al. 2007) describe a study in Hong Kong whereas (Chu et al. 2012) reported ketamine detected in small numbers of drivers subjected to random roadside testing in Australia.

General effects and clinical signs: Positive effects claimed by users include feelings of intense power and energy, plus "dream like" states and "out of body" experiences; however disorientation and confusion are not infrequently reported with vivid hallucinations and delirium. The adverse of ketamine include anxiety and agitation, with paranoia and frank psychotic episodes associated with visual, auditory and perceptual hallucinations, whereas the physiological side-effects include irregular heart palpitations and chest tightness, plus muscle stiffness and occasionally seizures.

Psychomotor effects: The major safety concerns following ketamine use relate to depersonalisation effects including vivid hallucinations and psychotic episodes coupled with decrements in higher cognitive functions. Decreased awareness of self or surroundings linked with distorted perceptions of space, increased reaction time, non-responsiveness, and blurred vision are the major elements responsible for these marked performance decrements.

1.3.6. Hallucinogens: LSD.

Lysergic acid diethylamide (LSD) is an hallucinogenic, psychedelic agent and is manufactured from lysergic acid, an ergot alkaloid which occurs naturally in the ergot fungus which grows on wheat and rye cereal grains.

Epidemiology: There is a paucity of publications relating to LSD use in drivers however Moeller and Kraemer (2002) and Isralowitz and Rawson (2006) report use in Germany and Israel respectively. LSD use among dance clubbers in Scotland has been reported (Riley et al. 2001).

General effects and clinical signs: Physiological signs of LSD use are CNS stimulant and include tachycardia, hypertension, dilated pupils, tremor, sweating, occasional pilo-erection (gooseflesh) anorexia, dry mouth and insomnia. Psychological effects of LSD are visual and auditory hallucinations with distorted sensory perception, abnormal mental state including altered thought processes, delusions, temporal distortion, and temporary psychotic episodes. These effects are unpredictable and can depend upon the subject's individual personality and mood.

Psychomotor effects: Due to the distortion of temporal perception induced by LSD the detrimental performance effects are related to reaction time, both visual and auditory, and both simple and choice. In addition due to the disordered dream like state induced by LSD the subject's general awareness and alertness are also significantly negatively affected. Although epidemiological studies suggest the incidence of driving under the influence of LSD is extremely rare there can be no doubt LSD use is entirely incompatible with safe driving.

1.3.7. "Legal highs" - Mephedrone; BZP; Synthetic Cannabinoids.

"Legal Highs" are relatively new drugs which were sold legally in the UK since 2007 and include Mephedrone; BZP and synthetic cannabinoids. However in December 2009 the Home Office declared BZP and the synthetic cannabinoids illegal under the Misuse of Drugs Act 1971. In April 2010 Mephedrone was also declared illegal as a Class B drug under the Misuse of Drugs Act 1971.

Little is known regarding the prevalence of these drugs and information is based mainly on anecdotal evidence. However the National Addiction Centre conducted a survey via a social magazine and received 2,200 responses in relation to use of "legal highs" and 59% of respondents admitted use of such substances Jackson and Hilditch (2010). The most popular "legal high" was nitrous oxide (59%); Mephedrone (42%); Salvia (salvia divinorum - a psychoactive plant) (29%); BZP (26%); Synthetic cannabinoids "spice" (13%) and GBL (6%).

Mephedrone:

Mephedrone is a member of the cathinone group of stimulant drugs which are extracted from the khat leaves and which are controlled under the Misuse of Drugs Act 1971. The effects described by users are similar to those of "ecstasy" and cocaine. Positive effects are claimed to be feelings of increased sociability and empathogenic feelings with talkativeness, excitement, alertness and occasional euphoria. Negative effects include nausea, vomiting, blurred vision, anxiety, paranoia, tachycardia and fits (Jackson and Hilditch 2010).

Since this substance has effects and side effects similar to the amphetamine stimulants, ecstasy and cocaine, it is logical the adverse effects on driving would be expected to be similar and these are anticipated to include visual distortion, lack of concentration, irritability, disordered awareness, occasional frank hallucinations, and increased risk taking behaviour.

BZP (1-benzylpiperazine):

BZP is a synthetic CNS stimulant producing similar effects to amphetamines and MDMA (ecstasy) but significantly less intense and probably in the range of 10% of d-amphetamine. Despite the reduced stimulant and hallucinogenic effect BZP has been associated with nausea, vomiting, anxiety, mood swings, confusion and hallucinations and paranoia. The CNS stimulant effects will affect safe driving due to concentration decrements; anxiety and distorted perception, while the increased risk-taking and potential hallucinogenic effects clearly are likely to compromise safe operation of a motor vehicle.

Synthetic Cannabinoids:

These compounds mimic the psychoactive effects of delta-9 tetrahydrocannabinol (Δ9-THC), which is the active compound in cannabis. They are however much more potent than Δ9-THC and used in much lower doses. They are sprayed onto a herbal mix and sold as incense known as “Spice”. Regarding the risk to health very little is known in relation to these compounds and there are estimated to be hundreds of

varieties available (Jackson and Hilditch 2010). These high potency cannabinoids will carry a significantly greater risk to road safety than "standard" cannabis with more severe detrimental effects on the cognitive and psychomotor performance of the "users". It is anticipated severe decrements will be noted in perception, vigilance and co-ordination with greater evidence of tracking errors reported.

1.4. Medicinal drugs and driving.

The role of prescription medications used to treat medical conditions and the impact on road safety is an area of research, which has produced mixed results. Longo et al. (2000) studied 2500 injured drivers and found an increased risk for drivers using benzodiazepines at the therapeutic range or above. However other studies (Skegg 1979; Ray 1992; Leveille et al. 1994; Barbone et al. 1998) have not all shown an increase in risk for road traffic collision and benzodiazepine use. Indeed it has been reported that treatments for anxiety with benzodiazepines improve the condition although not the impaired driving performance of the patient (de Gier 1998).

Starmer (1985) studied the effect of anti-histamine use and highway safety and later analysed a prospective study investigating the link between prescription tranquillisers and road crash involvement over a two-year period. It was concluded that subjects prescribed minor tranquillisers were significantly more likely to be involved in a serious road traffic incident, with those involved in a fatal crash being 4.9 times more likely to have prescribed tranquillisers than the control subjects.

Research studies on depressed patients suggested that treatment with tri-cyclic anti-depressants can improve the driving ability of the patient, despite the medication having sedative properties that would impair the driving ability of non-depressed individuals (Hobi et al. 1982; Greenblatt and Shader 1992).

More recent studies have also suggested that in the patient whose condition has an adverse effect on their driving ability, the benefits of treatment in respect of improved alertness, concentration and attention can compensate for any detrimental side-effects (Wingen et al. 2005; Berghaus and Hilgers 2009; Brunnauer and Laux 2010).

The medicinal drugs of particular concern in road safety and driving are –

Sedatives and anxiolytics – particularly benzodiazepines.

Anti-depressants – particularly tri-cyclics.

Neuroleptic agents (major tranquillisers) – chlorpromazine and haloperidol.

Narcotic opioids – methadone, diamorphine, buprenorphine.

Antihistamines – particularly first generation.

1.4.1. Benzodiazepines - Diazepam.

Benzodiazepines (BZDs) are CNS sedative anxiolytics with a muscle relaxant effect and as a result users may experience lethargy, lack of attention, vigilance decrements and drowsiness with impaired motor co-ordination and psychomotor functions. Although legal, benzodiazepines are drugs of concern in respect of road safety due to their widespread use as prescribed drugs, but also due to their widespread availability and use as a "street drug" (McCabe and Boyd 2005; North 2010a). Laboratory and simulator studies have shown benzodiazepines produce performance decrements varying from sedation in low doses to hypnosis in high doses (Stevenson, Pathria, Lamping et al 1986; Landauer 1986; Leigh, Link and Fell 1991; Leufkens et al. 2007).

Epidemiology: Benzodiazepines such as diazepam are widely prescribed not only in the U.K. and throughout Europe but also in North America and the southern hemisphere and multiple studies have reported the drug detected in drivers' blood samples (Everest Tunbridge and Widdop 1988; Ray, Fought and Decker 1992; Terhune et al. 1992; Gjerde, Beylich and Morland 1993; Leveille et al. 1994; Augsburger and Rivier 1997; Hemmelgarn et al 1997; Barbone et al. 1998; De Gier 1998; Hildegard and Berghaus 1998; Schepens et al. 1998; de Gier 2000; Longo et al. 2000 and 2000a; Tunbridge and Rowe 2000; Brault et al. 2004; Fitzpatrick, Daly, Leavy and Cusack 2006; Normann et al. 2007; EMCDDA Insights 2008f; Hingson 2010).

***General effects and clinical signs*:** At low doses diazepam is a moderate tranquiliser which can result in impaired alertness, muscle weakness, lethargy, light-headedness, drowsiness and confusion; whereas at higher doses its effects are somewhat similar to alcohol intoxication with slurred speech, disorientation, inco-ordination and ataxia; while at toxic levels the subject may exhibit dis-inhibition with wild excitement, or indeed severe sedation, and on occasion respiratory depression.

***Psychomotor effects*:** The most important side-effects of benzodiazepines (BZDs), which lead to impairment of driving performance, are sedation and somnolence, loss of motor co-ordination, memory impairment. BZDs impair driving performance notably by interfering with visual perception, speed perception, future events perception, and vehicle control. These difficulties stem mainly from the drug's sedative effects, which are strongest when the drug is initially taken and become less significant as the patient develops a tolerance to both the effects and side-effects.

Significant performance deficits in psychomotor function and driving related functions following benzodiazepine use have been reported (Skegg, Richards and Doll 1979; Moskowitz and Smiley 1982; Willumeit, Neubert, Ott and Hemmerling 1983; Kunsman Manno, Manno et al. 1992; Kunsman, Manno, Przekop et al. 1992; Preston, Wolf, Guarino and Griffiths 1992; Van Laar 1992; O'Hanlon et al. 1993; Danjou et al 1999; Mintzer and Griffiths 1999; Compton, Shinar and Schechtman 2000; Van Laar, Volkerts and Verbaten 2001; Matthews, Kirby and Martin 2002; Verster at al. 2002; Logan and Couper 2004; Rich, Svoboda and Brown 2006; Leufkens et al. 2007; Grellner 2010).

1.4.2. Anti-depressants:

Antidepressants are CNS psychoactive agents used to treat not only depression, but also panic disorders, eating disorders, phobias and obsessive-compulsive behaviour.

Epidemiology: Studies showed that the use of anti-depressants in drivers is widespread and may be linked to increase risk of road traffic accidents due to the significant sedative effects of the early tri-cyclic antidepressants (Ray et al. 1992; Leveille 1994; O'Hanlon 1995; O'Hanlon et al. 1998; McGwim 2000). However it has been reported the modern agents venlafaxine, fluoxetine and paroxetine have not been associated with impairment of driving (Ramaekers, Muntjewerff and O'Hanlon 1995; O'Hanlon et al. 1998; Ridout, Meadows, Johnsen and Hindmarch 2003).

General effects and clinical signs: Among the unwanted secondary effects of antidepressant drug therapy are sedation, tremor, insomnia, blurred vision, mental confusion and dizziness. These effects and their intensity depend on the molecule, on the dose, timing of administration and the individual sensitivity. The side-effects of the tricyclic compounds can be severe resulting in significant sedation and mental dullness however the more modern antidepressants have fewer adverse effects although the SSRIs (selective serotonin re-uptake inhibitors) have recently been linked to increase in suicide rates (Healy and Whitaker 2003; Gunnel, Saperia and Ashby 2005).

Psychomotor effects: These are directly related to the class of drug used with the earlier agent being responsible for significantly greater sedation than the modern drugs. Multiple studies reported the early tricyclic antidepressants drugs (TCAD) to have significant adverse effects on psychomotor assessment (Ramaekers, Swijgman, and O'Hanlon 1992; Ramaekers, Muntjewerff, and O'Hanlon 1995; van Laar, van Willigenburg, and Volkerts 1995; Ramaekers 2003). However studies of the modern SSRI agents report no adverse psychomotor effects (O'Hanlon, Robbe, Vermeeren, van Leeuwen and Danjou 1998; Devanand et al. 2003; Constant et al. 2006; Dumont et al. 2005; Wadsworth et al. 2005; Wingen et al. 2005; Rose et al. 2006).

It has been reported that successful anti-depressant therapy can improve the driving performance of depressed patients due to the drug relieving the depressive symptoms (Greenblatt & Shader 1992; Berghaus and Hilgers 2009; Brunnauer and Laux 2010).

1.4.3. Neuroleptics.

Neuroleptics are CNS psychoactive sedative agents used in the treatment of psychoses characterised by disturbances of the thought processes leading to distortions of affective responses (mood) and reality. These drugs are frequently prescribed to the not insignificant percentage of the general population who suffer from major psychiatric disorders (Carney, Jones and Woolson 2006). Little research has been conducted regarding the effects on driving ability in patients using neuroleptic agents however it has been reported that schizophrenic patients demonstrate improved psychomotor performance during chronic treatment with antipsychotic drugs (Judd 1985).

***General and psychomotor effects**:* The major impairing side effects of neuroleptics are sedation, deterioration of cognitive function, reduction of visuo-motor abilities and of vigilance, aggressive tendencies, and temporary aggravation of psychotic problems. It has been reported however, that without adequate treatment, patients can demonstrate a variety of cognitive problems, and attention or motor deficits, which are more detrimental to safe driving than the adverse affects of the medication. Indeed use of neuroleptic agents may allow the patient to resume normal social activities including driving Judd (1985).

1.4.4. Methadone.

Methadone hydrochloride is a synthetic narcotic analgesic and is a schedule II controlled substance. Methadone is an analgesic for the relief of moderate to severe pain, and is used in detoxification treatment of opioid dependence and maintenance in narcotic addiction. Recreationally, methadone is abused for its sedative and analgesic effects.

General effects and clinical signs; The clinical or physiological signs of recent methadone use include dry mouth, facial flushing, nausea, constipation, respiratory depression, muscle flaccidity, pupil constriction, and decreased heart rate. The psychological effects range from dizziness and light-headedness, mood swings, drowsiness and sedation, through altered sensory perception including analgesia and depressed reflexes to clinical stupor and eventually a comatose state. The most serious unwanted effects of methadone result from the powerful CNS depressant activity and include sedation, reduced cognitive function and respiratory depression.

***Psychomotor effects**:* The major effects relevant to methadone in relation to driving safety are sedation, impairment of cognitive functions, mood changes including dysphoria and euphoria, impairment of psychomotor functions and pupil restriction. Sedation and cognitive impairment may be noted at initial stages of treatment but less so after some days or weeks. Laboratory studies have shown no significant psychomotor impairments when stable long-term subjects have been tested and in the majority of experimental clinical trials (Mintzer and Stitzer 2002).

It has been reported that non-tolerant individuals receiving single doses of methadone have been noted to have dose-dependent reductions in reaction time, visual acuity, and information processing, with sedation being readily recognisable (Stout 2003; Couper et al. 2004). However European studies of long-term methadone maintenance patients have indicated that appropriately administered methadone does not cause significant psychomotor or cognitive impairment when administered regularly and when the subject abstains from all other drugs (Stout 2003; Fishbain et al 2003; Strand, Fjeld and Arnestad 2010). However it has been reported that opioid maintenance therapy OMT studies in Norway resulted in “conflicting results” due to some patients receiving benzodiazepine therapy in addition to the methadone (Bramness 2010).

Current DVLA regulations permit driving licenses to be held by persons whose opiate addiction has been controlled following successful detoxification therapy, and are stabilised on daily methadone and who use no other drugs, subject to certification by their medical attendants or drug treatment officers.

1.4.5. Morphine.

Morphine is an analgesic agent used clinically for the relief of moderate to severe acute and chronic pain, and also used in anaesthetic pre-operative sedation. The effects of these substances on any given subject will depend on the specific drug used, the route of administration, but also previous exposure which will be reflected in the individual's tolerance to the particular drug.

Epidemiology: Chronic opiate maintenance therapy is commonly used to control long-term pain in patients suffering from terminal cancer, some of whom may have continued mobility and use of a motor vehicle and thus drive regularly whilst prescribed significant dosages of morphine.

General effects and clinical signs: The behavioural effects of opiates are recognised to include among other things, a feeling of well-being, euphoria, lethargy, sedation and mental confusion (Huestis and Smith 2009a). Clear evidence of lethargy, sedation and performance decrements in psychomotor tasks has been recorded in opiate naïve volunteers for periods of 4 to 6 hours after oral ingestion with significantly decreased alertness and sedation obvious and performance decrements such as reduced reaction time and significant deterioration in performance on divided attention tasks. However chronic use of oral morphine leads to tolerance, which reduces the undesirable side effects.

Psychomotor effects: Due to the powerful narcotic effects all patients started on morphine therapy are warned to expect sedative side effects in the initial treatment phase and must be cautioned against driving if significantly affected. After a relatively brief period patients will develop a tolerance to the drug when taken in moderate regular doses. Patients stabilised on long-term opiate maintenance therapy who develop tolerance show no significant decrements in psychomotor performance (Vainio et al. 1995; Galski, Williams, and Ehle 2000; Hill and Zacny 2000; O'Neill et al 2000; Walker at al. 2001; Fishbain et al. 2003; EMCDDA 2008h; Morland 2010).

1.4.6. Anti-histamines.

Anti-histamines are used for treating allergies such as hay fever and urticaria, and travel-sickness. The most significant effect of antihistamines in respect of safe driving relates to their potential to induce sedation (Richardson et al. 2002; Turner et al. 2006; Theunissen, Vermeeren, Ramaekers 2006). This undesirable side effect, which has been most commonly observed with the first generation compounds such as diphenydramine, is a consequence of the depressive activity on the CNS due to this group of drugs' ability to cross the blood-brain barrier. Newer agents such as astemizole and terfenadine do not cause significant sedation because of their poor penetration of the CNS and blood-brain barrier Hindmarch et al. (2002).

Psychomotor effects: Diphenhydramine and other 1st generation antihistamines are linked with impairment in cognitive functions and psychomotor performance and in particular lethargy, sedation, drowsiness and decreased alertness with associated decrement in reaction time, both simple and choice; and impairment in concentration and attention and diminished performance in tracking ability (Couper et al 2004).

The individual classes of histamine antagonists have been studied (Betts et al. 1984; Starmer 1985) and the researchers independently concluded these different classes of drugs had quite different effects on psychomotor performance and had different implications in respect of road safety. Their investigations found that the older H1 antagonists were associated with sedative effects which resulted in a performance decrement in laboratory based tasks however the more modern H2 antagonists had no detrimental effects.

These findings have been confirmed by multiple researchers (O'Hanlon 1988; Ramaekers, Uiterwijk, and O'Hanlon 1992; Ramaekers and O'Hanlon 1994; Vuurman, Uiterwijk, Rosenzweig, and O'Hanlon 1994; O'Hanlon and Ramaekers 1995; Vermeeren and O'Hanlon 1998; Nicholson et al. 2002; Moskowitz and Wilkinson 2003; Theunissen, Conen and Ramaekers 2010).

1.5. U.K. Government awareness of drug driving problem.

In January 1998 the UK Department of Environment Transport and the Regions (DETR) published findings of the first 15 months of a 3-year study into the incidence of drugs in road accident fatalities (DETR 1998). There were a total of 619 road traffic fatalities and over 6% of these tested positive for medicinal drugs, 18% for illicit drugs (mainly cannabis), and 34% for alcohol. Although the incidence of medicinal drugs had not significantly changed from the 1985 - 1987 study it was noticeable that illicit drug use had increased six fold in percentage terms from 3% to 18%. Another study undertaken in 2000 noted that at least one medicinal or illicit drug was detected in 24.1% of the 1184 road traffic casualties tested (Tunbridge, Keigan and James 2001). The research also revealed that there had been a substantial increase in the incidence of cannabis detected in fatal road traffic casualties from 2.6% in 1989 to 11.9% 2001.

In Scotland a study reported on blood samples submitted to the forensic science laboratory in Edinburgh in relation to drivers arrested under Section 4 of the Road Traffic Act 1988 over a 12 year period from 1996 to 2008. In total 423 samples were analysed. It was found cannabinoids were present in over 40%; benzodiazepines had doubled in frequency to over 80%; methadone had increased from 2% to 23% and morphine from 2% to 31%. A notable finding was the huge increase in poly-drug use with samples containing 4 or more drugs increasing from 4% in the 1996 to 2000 period, to 25% in the 2008 group (Officer 2009).

1.5.1. U.K. Legislation drugs and driving.

The legal consequences of driving under the influence of alcohol and/or drugs are regulated as crimes in specific road traffic laws throughout the United Kingdom. The statutory offence relating to drugs and driving is contained under Section 3A and 4 of the Road Traffic Act 1988 (as amended by S4 of the Road Traffic Act 1991).

- The Road Traffic Act of 1988 – Sections 5 and 4.
- The Railways and Transport Safety Act of 2003.

1.5.2. Road Traffic Act 1988 – Section 4.

This legislation empowers police officers to arrest the driver of a "mechanically propelled" motor vehicle if there is suspicion that the person has either been driving or has been attempting to drive the vehicle while unfit through drugs.

The Road Traffic Act 1988 amended section 4(1) states -

"A person who, when driving or attempting to drive a motor vehicle on a road or other public place, is unfit to drive through drink or drugs shall be guilty of an offence".

Under the legislation of the Road Traffic Act (1988) the term "drugs" is defined as any intoxicant other than alcohol – which infers any substance, which has the potential to affect the normal function of the Central Nervous System. The "Impairment" based regulations require proof that the driver is unfit to drive as a direct result of the effect of alcohol or drugs.

Robinson (1996) has observed that the Road Traffic Act 1988 has defined "unfit" as follows – *"A person shall be taken to be unfit to drive if his ability to drive properly is for the time being impaired"*

However Stark et al. (2002) have noted -

"*Impairment is not defined under the Act; it is a decision reached by the Court after hearing evidence from several sources including any witnesses, arresting police officers, police doctor, and forensic toxicologist.*"

Study of recent publications indicates some difference of opinion exists regarding the responsibility of the forensic medical examiner (FME) called by police to examine any motorist suspected of drug-related impairment of driving, in compliance with the requirements of Section 4 of the Road Traffic Act 1988.

Sexton et al. (2000) in the Transport Research Laboratory Report 477 state –

"The aim of the examination is two-fold; firstly to ensure that the person is fit to be in a police station – that there is no evidence of injury (e.g. head injury following a road traffic accident) or a medical condition (e.g. hypoglycaemia) requiring treatment, and secondly to determine whether the person is impaired to drive or whether there is a condition that might be due to a drug."

Wall and Karch (2005) take a different view –

"In the U.K. it is not necessary to prove impairment, as Section 7 (3) of the RTA states the suspected offence is one under Section 7 3(A) or 4 of this Act and the constable has been advised by a medical practitioner that the condition of the person required to provide the specimen might be due to the effect of some drug. It is for the court to decide whether the driver is unfit to drive on the evidence before it."

As a result of nationwide training programmes it should now be beyond doubt that the FME is not required to diagnose impairment but simply to state whether or not the driver has a clinical condition, which ***might be*** due to the effect of a drug(s).

1.5.3. Preliminary Field Impairment Tests (PIT / FIT).

Strathclyde Police Scotland, in conjunction with several other forces in the United Kingdom, conducted a trial in July and August 1999, during which period, Field Impairment Tests (FIT) which are identical to Standardised Field Sobriety Tests (SFSTs), were applied to suspect drivers at the roadside. Following completion of the trial which was perceived to be successful, the techniques were presented to the Association of Chief Police Officers with the recommendation FIT be incorporated into a national training package for police officers and FMEs.

These SFSTs which were pioneered in the U.S.A. almost 40 years ago, have influenced training in various countries, and have been claimed to have been validated, both in laboratory and roadside conditions (Burns 1995). The tests which assess the psychomotor status and cognitive functions also include a "divided attention" component designed to assess the ability of the subject to pay attention, follow simple instructions, and to divide attention between multiple tasks and demands made simultaneously. The "divided attention" assessment is purported to be relevant in respect of the multiple tasks required to satisfactorily drive a motor vehicle. It has been suggested (Fleming and Stewart 1998) – *"The individual who is unable to divide his or her attention will frequently forget part of the instructions".*

A pupillary assessment and four specific tests were recommended for use:

- The One Leg Stand Test
- The Walk & Turn Test
- The Finger to Nose Test
- The Romberg Test

It is important to acknowledge that these "tests" which have been validated for the effects of alcohol-related impairment at blood alcohol concentration (BAC) of 0.10 (100 mg alcohol per 100 ml blood) remain to be validated for drug-related evidence of driving impairment (AFP 2003; FFLM in North 2010d; Stark 2010).

It is also important to acknowledge no direct or causal link has yet been established between poor performance in FIT and the recognised effects or side-effects of drugs (Hartley 2001; Irvine 2002). It is questionable what relevance such dated tests for alcohol effect have in relation to impairment of driving ability following drug use.

Furthermore these tests have been widely criticised Trocino (1997); Head (2001); Hartley (2001); Johnson and Ramsey (2003) and as such are open to legal challenge.

However perhaps the major problem with FIT/PIT is that despite the name, they are not tests of driving impairment - Read (2003).

1.6. Impairment of driving ability.

Impairment of driving ability is not defined within the Road Traffic Act 1988 however may be described as a reduction in the ability to adequately perform the various elements of the driving task in order to travel safely on public highways. These elements include maintaining alertness and vigilance, awareness and perception of potential hazards; judgment and decision-making; and the appropriate motor performance of steering, braking and retaining full control of the vehicle.

The Department for Transport Road Safety Division (2001) has declared that impairment of driving may be related to general health and physical conditions; psychological conditions; inappropriate consumption of alcohol, drugs and/or other substances; fatigue and sleep deprivation; and distraction from the driving task.

The concern that certain drugs may impair driving skills is shared by the medical community, regulatory bodies, the transport industry and not least by the general public. This issue is of particular importance because drug use in general, has increased markedly in recent years, not only due to a rise in the use of prescription medicines among an expanding and ageing population, but also to the increased use of illegal "street drugs" in the general population which is known to have increased dramatically in recent years North (2010a). It has been reported by that there are consistent patterns to the drugs which show up most frequently in drivers with cannabis, cocaine, amphetamines, benzodiazepines, and opiates invariably appearing in the top five irrespective of jurisdiction (Logan 2010).

Both prescription drugs and illicit drugs are frequently detected in populations being studied, including arrested drivers (de Gier 1998; Jones et al. 2007); fatally injured drivers (Schwilke et al. 2006; EMCDDA 2008f; road trauma patients Longo et al. 2000a; Walsh et al. 2005); and roadside survey or checkpoint subjects (Hildegard and Berghaus 1998; Normann et al. 2007; Lacey 2010).

1.6.1. Evidence of Impairment and psychomotor tests.

When we consider Section 4(1) of the Road Traffic Act 1988 it should be acknowledged that there is an essential difference between detecting psychomotor performance deficits in a subject who has a detectable level of a drug in their system; and testing for the presence of impairment of driving ability which has been caused directly by the effect of a specific drug.

Laboratory type tests may be applied and these tests can be subdivided in to two categories namely -

(i) psychological

(ii) physiological

The first assesses how a drug affects **psychological performance**, such as attention, vigilance, temporal processing and psychomotor functions such as reaction time and tracking ability.

The second type of test examines the effect of drugs on **physiological functions** such as balance and co-ordination, locomotor function, eye movements, pupil size, visual ability, blood pressure and pulse rate.

A pre-requisite of any test including drug impairment tests, is that it must fulfil certain criteria before it can be used confidently and reliably by any law enforcement agency or legislative body or process, particularly in a judicial arena.

The pre-requisites with which the test must comply are **-**

(i) Sensitivity

(ii) Reliability

(iii) Validity

Regarding the use of drugs and driving, any test fit for purpose must therefore -

- Be capable of measuring a specific effect
- Measure the effect accurately and reliably
- Have a standardised simple and easy administration procedure
- Measure tasks related to the act of driving
- Have a valid pass/fail criterion level
- Measure what is claimed to be measured
- Be fair with respect to language, culture, age, gender, experience
- Be appropriate to population norms
- Require only a relatively short time to complete

The validity of experimental tests measuring driving skills or skills related to driving has been the subject of detailed scrutiny (Owens and Ramaekers 2009a) who concluded -

"*Although various investigators have claimed that their task or battery taps driving related skills, most studies show no proof for such a claim or even a reasonable theoretical rationale.*"

1.6.2. Impairment of Driving - Clinical Tests of Impairment.

A significant problem with the laboratory tests relates to the validity of the test battery in general, and the face validity in particular. In an attempt to address these shortcomings and to design tests more likely to assess the skills related to the driving act, various clinical tests have been formulated and the great majority appear to be based on the Standardised field Sobriety Tests (SFST) which originated in the USA.

These SFSTs were developed in the 1970s to assist police officers to detect a BAC or blood alcohol level greater than .10 which equates to 100 mg/100 ml blood, however despite this these SFSTs have been renamed as field Impairment Tests (FIT) and have been adopted as tests of drug-related impairment by the United Kingdom, several E.U. countries, Canada and Australia. An enhanced clinical test battery is used in Norway involving 25 Clinical "subtests" known as the Norwegian CTI25 tests (Bramness, Skurtveit and Morland 2003).

The methods which have been used in the USA are -

1. The Drug Evaluation and Classification programme (DEC) which uses the drug recognition experts (DREs) and a 12 step examination process.
2. The Standardised Field Sobriety Tests (SFSTs).

The method used in the U.K. is the roadside Field Impairment Testing process (FIT), now known as the Preliminary Impairment Test (PIT). This method was adopted in the U.K. in 2003 following completion of pilot studies of FIT.

1.6.3. The U.S.A. Drug Recognition Expert (DRE).

In the early 1970s officers from the Los Angeles Police Department (LAPD) found that a growing number of drivers stopped under suspicion of being impaired were testing negative on the breathalyser however appeared to be impaired. LAPD officers worked with a local medical examiner to formulate a systematic programme whereby police officers could be trained to observe, and document, known signs and indicators of drug use and impairment. This programme was then standardised and

field-tested over a number of years before it was eventually accepted by the LAPD and introduced in 1979. The programme is called the Drug Recognition Expert programme (DRE) and, under the system, the medical examiner is replaced by the DRE who is a trained police officer. The programme is also known as the Drug Evaluation and Classification (DEC) programme.

The purpose of the DRE examination is threefold -

1) To confirm impairment is not consistent with the alcohol effects
2) To determine whether the impairment is drug related or caused by a medical condition or injury.
3) To determine the category/categories of drugs responsible for the impairment.

In order to do this, the DRE carries out a 12-step examination process:

1. **Breath alcohol test-** this is carried out by the arresting officer.
2. **Interview with the arresting officer** to gather baseline information.
3. **Preliminary examination** including first recording of pulse.
4. **Eye examination** for horizontal and vertical gaze nystagmus, and convergence.
5. **Divided attention tests** are conducted.
6. **Vital signs examination -** BP, temperature, and a 2nd pulse count are taken.
7. **Darkroom examination -** pupil size is measured
8. **Muscle tone -** limb tone is assessed for rigidity and flaccidity.
9. **Injection site examination -** plus a third pulse reading is taken.
10. **Interrogation -** a structured interview about the use of drugs is carried out.
11. **Opinion -** the DRE forms an opinion as to drug impairment and the type of drug.
12. **Toxicology testing -** samples are obtained for toxicological examination, either a blood or urine sample being taken for analysis of common drugs

1.6.4. Standardised Field Sobriety Tests (SFSTs).

Six specifically selected tests were evaluated in the study as follows.

1. **One Leg Stand:**
2. **Walk and Turn:**
3. **Finger to Nose**:
4. **Finger count:**
5. **Horizontal Gaze Nystagmus (HGN)**
6. **Finger Tracing:**

Evaluation studies suggested a high degree of sensitivity and specificity and tended to validate this procedure. The study authors concluded that all of the field sobriety tests examined were "alcohol sensitive", but that the **Walk and Turn**, **One Leg Stand**, and **Horizontal Gaze Nystagmus** tests were the most effective at correlating with **BACs of .10%** or more and it was concluded that these were the best tests for further development (Tharp, Burns and Moskowitz 1981; Burns and Adler 1995).

However subsequent detailed analysis of the results of the limited studies conducted, suggested that the results of the DRE assessment might not have been sufficiently accurate to permit a reliable evidence base to be presented in court. Doubt had been cast on their "expert" status particularly by specialist legal defence agents (Erwin 1995; Trocino 1997; Head 2001; and Rubenzer 2008).

Indeed Trocino (1997) claimed a lack of impartiality on the part of the author of the initial studies which tended to validate the DRE programme, Dr Marcelline Burns, a research psychologist whom he claimed - "*was intimately associated with the DRE protocol and involved in the Los Angeles test which touted the DRE accuracy*".

A thorough and detailed review of the SFST was produced (Fazzalaro 2000) which declared no scientific basis for the tests, which had never been validated for drug related impairment of driving.

1.6.5. Validation of the SFST Battery (1995).

Intriguingly, the SFST test battery was "validated" by one of the original main authors in the 1995 Colorado validation study finally completed in August 1998 (Stuster and Burns 1998). NHTSA commissioned the principal researcher Dr Burns of the Southern California Research Institute who concluded that for the 234 subjects who provided samples, the police officers decisions to arrest or release were correct in 86% of the cases.

1.6.6. Criticism of the SFST Research.

Criticism of the SFST battery has been voiced by various defence agents regarding alleged deficiencies in the research supporting Field Sobriety Tests in general and the SFST battery in particular. It has been asserted that the tests are inherently subjective as opposed to being appropriately objective.

It has been claimed that multiple external factors including the unusual nature of the tests, the delivery of the tests, pressures placed upon the driver, and the individual police officer, can affect the interpretation of the test results (Erwin 1995).

However the major criticism of the use of the "Field Sobriety Tests" was the fact that these tests were being used for a purpose they had not been designed for - essentially to identify impairment of driving ability. It was noted the primary purpose for developing the SFST battery was to assist a police officer in making an arrest decision. However the tests were specifically designed to determine whether a subject's BAC was above or below .10%. The tests were not designed to detect whether or not a person's driving ability was impaired, and certainly not impaired due to the effects of drugs.

Regarding the initial studies (Stuster and Burns 1998) which claimed that DRE opinions were confirmed by toxicology in the 74 to 92% of cases when the DRE concluded that the suspect was impaired, it has been highlighted that published trials in which blood levels were measured before and during the DRE examination, have shown that DRE assessment agreed with the toxicology findings only in 32 to 44% of cases (Wall and Karch 2000; Wall and Karch 2005).

More recent opinion (Rubenzer 2008) has strongly re-inforced the position taken by Erwin (1995) following his assessment of the tests in relation to relevant scientific, psychometric, and legal issues and concluded –

"The research that supports their (SFST) use is limited, important confounding variables have not been thoroughly studied, reliability is mediocre, and that their developers and prosecution-oriented publications have oversold the tests. Further, case law since their development has severed the tests from their validation data, so that they are not admissible on the criterion for which they were validated (blood alcohol concentration), and admissible for a criterion for which they were not (mental, physical, or driving impairment)".

1.6.7. U.K. Field / Preliminary Impairment Tests (FIT / PIT).

FIT currently in use in the U.K. and now known as Preliminary Impairment Tests (PIT) are identical to the original Standardised Field Sobriety Tests minus the Horizontal Gaze Nystagmus Test and the Finger Count and Tracing Tests which were first introduced nearly 40 years ago to assess the blood-alcohol level. FIT/PIT assess the psychomotor status and cognitive functions and also include a "divided attention" component, which assesses the ability to pay attention, follow simple instructions, and divide attention between multiple tasks. This multiple task or "divided attention" assessment is purported to be relevant in respect of the multiple tasks required to satisfactorily drive a motor vehicle.

It has been suggested that the individual who is unable to divide his attention will frequently forget part of the instructions (Fleming and Stewart 1998).

A **pupillary assessment** and four specific tests are involved: **The Walk and Turn Test; The One leg Stand Test; The Finger to Nose Test; The Romberg Test.**

The **pupillary assessment** consists of a "measurement" of the eyes using a basic and unsophisticated hand-held gauge to assess whether constriction or dilation of the pupils is present with a range of 3.0 mm to 6.5 mm claimed by police officers as normal. This crude assessment permits at best an approximate estimation of pupil size in millimetres, is highly subjective, and prone to error. This is not reliable and should be contrasted for example with the practice of using a calibrated pupillometer and applying the Neurological Pupil index (NPi), which is an algorithm developed by NeurOptics® scientists to remove subjectivity from the pupillary evaluation.

The claim made that the normal pupil size lies within the range of 3.0 mm to 6.5 mm is open to question and is not supported by clinical textbooks or by peer-reviewed publications. No reference is made of the intensity of ambient light at the time of the pupillary measurement, which is known to affect the natural physiological response in pupil size. It is accepted beyond dispute that "normal" or natural pupil size will differ depending upon the degree of ambient light present, with pupillary constriction occurring automatically in bright direct light, and pupillary dilation occurring in dark environments. No peer-reviewed publications have endorsed this suggested "normal" range in pupil size of 3.0 mm to 6.5 mm, and virtually all academic studies have measured pupil size in healthy normal volunteers under varying light conditions (Winn et al 1994; Witting and Goyal 2003; Twa et al. 2004).

A further valid criticism of this alleged "normal" range of pupillary size relates to the lack of consideration for the normal physiological reduction in pupil size, which occurs with increasing age, both in light and dark conditions (Birren et al. 1950).

Most relevantly however, a specific study was undertaken to determine normative values and ranges for pupillary responses using the specific DEC programme protocols for pupil testing in non-impaired subjects, and also to appraise the suitability of the 3.0 to 6.5 mm pupil range as a potential sign of impairment under three separate lighting conditions (Richman et al. 2004). 250 healthy volunteers who had no visual or neurological problems were studied and the study authors (Richman et al. 2004) reported –

"It appears that the DEC range for pupil size (3.0 – 6.5 mm) might be too sensitive."

The **Walk and Turn test** involves the subject standing in a fixed position with one foot in front of the other while listening to 9 separate instructions and two questions prior to starting the test. The subject must walk and count out nine steps heel-to-toe in a straight line, turn by pivoting on his left foot, and walk nine heel-to-toe steps back without swaying, stopping, stumbling, using his arms for balance, taking too few or too many steps, or walking in other than a straight line. The relevant "clues", or indicators of impairment, displayed during the walk and turn test include observing the individual who stops walking, misses heel/toe, raises arms, steps off the line, does not turn as instructed and/or does not take nine steps in each direction, and if the individual does not count out loud as instructed.

The **One Leg Stand** test involves the subject standing with heels together, arms at sides, one leg raised 6 inches off the ground with the foot parallel to the floor, holding that position whilst counting for 30 seconds without swaying, or using arms for balance, or putting the foot down. A "clue" is displayed if, during the test, the individual sways, hops, puts a foot down, and/or raises his/her arms, or does not count as instructed.

The **Romberg** test assesses the ability of the subject to stand with eyes closed and head tilted back and estimate the passage of 30 seconds. Temporal disintegration is regarded to be present if the subject under-estimates or over-estimates the time interval, with a period of 20 to 40 seconds regarded as within acceptable levels. A further "clue" is displayed if the driver sways, steps, raises their arm(s), raises their head or opens their eyes during the test.

The **Finger to Nose** test assesses the body position awareness and requires the subject to stand with eyes closed and head tilted back and then to touch the tip of the nose with the tip of an outstretched finger in a specific sequence of left, right, left, right, right, left. During the finger to nose task a "clue" is displayed if the individual is unable to touch his/her nose as instructed and/or sways, steps, raises arms, raises head or opens eyes whilst standing.

These tests are rigidly conducted without the slightest deviation in instruction and are assessed in an equally rigid manner with no scope for leeway in the procedure.

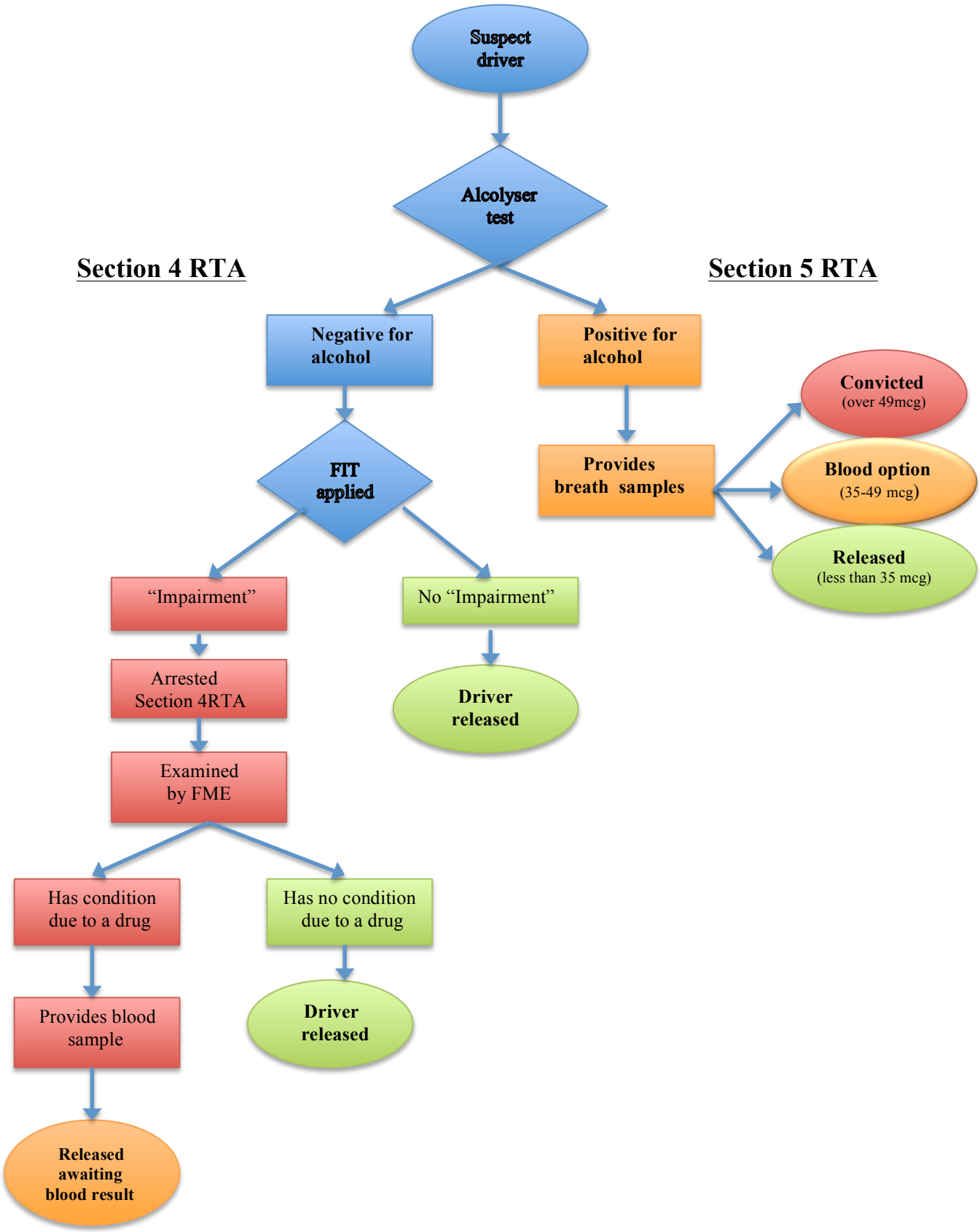
The Scottish Police Training College describe the tests as follows –

"The Preliminary Impairment Test (PIT) relatively simple to perform when sober, but sufficiently complex to divide the suspect's attention. The PIT process is a systematic standardised method of examining a suspect to determine whether or not that person's ability to drive is impaired. In reaching a conclusion as to whether a suspect's ability to drive, is or is not impaired, is based on the overall results of the test and not on any one aspect."

The entire procedure which must be rigorously followed in every case is detailed fully in Appendix A.

Current legal processes involved in assessing fitness to drive in a motorist suspected of being impaired through drugs are clearly outlined in legislation and have been outlined in diagrammatic form in the flowchart in Figure 1. These procedures are adopted in every case. Initially all drivers are required to provide a sample of breath analysed for alcohol content using a hand-held device and will then be processed through either Section 4 RTA or 5 RTA procedures depending upon alcohol reading.

Figure 1. Sections 4 and 5 RTA procedures and application of FIT.



1.6.8. U.K. Guidance for Medical Assessment suspect drug drivers.

A guideline regarding the clinical examination of a suspect drug-driver has been documented in the pro-forma issued by the Education and Research Department of the Association of Police Surgeons (Wall 2002) and this continues to be recommended by the Faculty of Forensic and Legal Medicine. The form is provided to assist the FME in determining whether a suspect driver ***"has a condition, which may be due to drink or drugs"*** and not necessarily due to "Impairment".

The form also reminds the police surgeon that in the UK the essential question required to be answered is -

"Has the suspect driver clinical evidence of a condition which might be due to some drug?"

It is not necessary for the doctor to determine "Impairment" or "Unfitness to drive".

1.6.9. Challenges in respect of the "Impairment" approach.

The legal basis for appropriate prosecution of suspect "drug drivers" is the state of impairment and not simply the presence of any drug in the suspect driver. However in the U.K. to successfully prosecute a driver under Section 4 of the Road Traffic Act 1988 it is necessary to establish a direct and causal link between -

1) The observed abnormality in performance as recorded in the CTI indicating that the subject appeared to be under the influence of drugs based on observations of their behaviour and demeanour; or of their driving.
2) The presence of the drug in the driver.
3) The established side effects of the drug in question.

Whilst it is not an essential pre-requisite of the Road Traffic Act, it might be desirable to have evidence of impaired driving since it has been recorded in the North Report (2010) cases have been rejected as –

"In England and Wales some Magistrates and the CPS required evidence from the police that driving was impaired." Also – *"Magistrates insistence that evidence of impaired driving was required to convict."*

It has been long acknowledged that most research based and clinically proven data known about alcohol and driving performance is not available for most drugs. A panel of experts reached a consensus concerning drug concentrations and driving impairment (Blanke et al. 1985) and reported -

"In order to establish that use of a drug results in impairment of driving skills, and to justify a testing programme to respond to this hazard, certain facts must be available.

1) *The drug can be demonstrated in laboratory studies to produce a dose related impairment of skills, associated either with driving, or with related psychomotor functions.*
2) *Concentrations of the drug and/or its metabolites in body fluids can be accurately and quantitatively measured and related to the degree of impairment produced.*
3) *Such impairment is confirmed by actual highway experience.*
4) *Simple tests such as can be done at the roadside by police officers with modest training can indicate the presence of such impairment to the satisfaction of the courts.*
5) *A range of concentrations of the drug can be incorporated in laws relating to impaired driving as ipso facto evidence".*

The panel concluded –

> "*These criteria have been met for alcohol. It is not certain they may be met for most drugs that are of concern to highway safety."*

Beirness (2010) has identified the strengths and weaknesses of the Impairment approach and regarded –

1) The **strengths** as the focus on the ability to drive safely, and the absence of the requirement for toxicological analysis of any type of sample.
2) The **weaknesses** being that the clinical signs (manifestations) may be subtle and difficult to recognise; such clinical signs produced are not similar to alcohol; the clinical examination process was time consuming and required significant training.

Mercier-Guyon (2010) has questioned whether best evidence might arise from clinical or behavioural signs, or indeed both. He queried the nature of impairment and suggested clinical signs of impairment in drivers following use of sedatives may be visible by experts, however signs were not always visible following use of stimulants. He stated the matter was further complicated when drivers had used both types of drugs in combination. He acknowledged the limitations of current clinical tests of impairment, particularly in relation to stimulant drugs, combinations of drugs and the new synthetic drugs recently being used and concluded that new "test batteries" should be proposed to detect drug related impairment of driving.

Porath-Waller and Beirness (2010) questioned which signs might best assist the DRE to identify types of drugs used by drivers and suggested a compromise between the drug recognition expert (DRE); the drug evaluation and classification (DEC) 12 step process; and field impairment tests (FIT) might be appropriate.

Verstraete and Legrand (2010) reported on the effectiveness of FIT as a checklist for clinical signs of impairment and detection of drugs in saliva on 250 subjects comprising 50 drivers and 200 subjects attending a methadone clinic. They reported

"Most parameters did not correlate significantly with drug intake. The pupils test seemed to be the best predicting parameters, especially for amphetamine and THC. The signs were often observed when high drug concentrations were found in saliva, but in many cases with high saliva drug concentrations, no signs were observed. In general, the checklist (FIT) correlated badly with drug presence in this population of chronic drug users, but our results also confirm other studies that found the (FIT) checklists are not very sensitive."

It would thus appear reasonable to acknowledge the limitations of current CTI batteries and FIT/PIT in particular, in respect of stimulant drugs, combinations of stimulant and sedative drugs, and the new synthetic drugs, which have recently becoming available. This re-inforces the need for thorough evaluation of FIT and highlights the relevance of the research studies which form the basis of the thesis.

1.7. Monitoring the effectiveness of FIT.

An independent report was commissioned by the DfT (Department for Transport) in an attempt to ascertain the effectiveness of Field Impairment Tests in identifying drugged drivers. Researchers from Glasgow University in Scotland conducted a detailed study and delivered their findings in the DfT Road Safety Research Report No. 63 - *"Monitoring the Effectiveness of U.K. Field Impairment Tests"* (Oliver et al. 2006). The authors sought to monitor the effectiveness of the overall battery of tests; and also to quantify the ability of the FIT battery to differentiate between drivers

impaired through drug use and those not impaired or drug free. They endeavoured to achieve this by calculating the degree of "correct" assessment of "Impairment" following use of FIT when correlated to the toxicological analysis of the samples received. They also attempted to determine the degree of correct assessment of "Non-Impairment" in drivers assessed to have successfully completed FIT and whose voluntary samples were analysed.

For the purpose of this particular study the police assessment of each individual driver's performance of FIT was judged against an objective measure, which was the presence of drugs in any sample obtained. In drivers arrested the biological sample was blood however in those drivers who were adjudged to have performed appropriately in FIT the sample was saliva. The authors acknowledged that the detection of drugs in blood or saliva did not indicate impairment; however suggested that the presence of significant concentrations of drugs confirmed the presumption of impairment when supported by police evidence of impaired driving.

Data for this project was collected from the eight Scottish police forces and 14 forces in England, Wales and Northern Ireland ending 30th July 2003. In total 991 cases were reported and from these 334 cases were deemed suitable for inclusion in the evaluation process and the information was used to calculate –

- the sensitivity (the proportion of true positive cases detected)
- the specificity (the proportion of true negative cases detected)
- the accuracy (the proportion of cases correctly diagnosed)

Moderate sensitivity (65%) and specificity (77%) and accuracy (66%) were recorded for FIT as a whole. Drugs were confirmed in 94% of all drivers judged to be impaired at the roadside and in whom the FME agreed there might be a condition due to the effects of a drug (i.e. positive predictive value).

It was a finding of note however that of those classed as not impaired by the police only 29% were found to be drug free (i.e. poor negative predictive value).

The study authors concluded -

1. FIT as studied was an effective screening test to identify drugged drivers.
2. Further development of FIT is necessary to improve the specificity and the negative predictive value of the tests.
3. The high number of drug positive drivers classed as "Not Impaired" is a cause for concern.
4. Further development of FIT is necessary and should include a control group of drug free individuals of varying ages such that "*normal responses to the use of FIT"* might be obtained and available for baseline comparisons.

1.8. Hypothesis and objectives of the thesis.

The aim of this thesis is to investigate the validity of the current Field Impairment Tests (FIT) in relation to their stated function as indicators of impairment in driving ability due to the effects of recent drug use. The thesis has tested the overarching hypothesis – **"Field Impairment Tests (FIT) are not reliable or valid indicators of drug-related impairment in driving ability".**

The specific questions in respect of FIT which the thesis will address are:

1. Can FIT reliably identify or detect evidence of recent drug use in subjects?
2. Can FIT be accepted as reliable and valid indicators of drug-related impairment in driving ability?

In order to address these questions various research tools have been utilised and the results analysed. These include postal questionnaire surveys of three separate groups of forensic physicians (FPs) experienced in examining suspect "drug-drivers". Detailed analysis of these surveys clearly indicates that a significant percentage of 33% of FPs ($p<0.0001$). also known as forensic medical examiners (FMEs) consider FIT to be an inappropriate test battery for their stated purpose.

More importantly however, the clinical research studies conducted on the three separate core groups, each of 100 subjects who were examined and assessed using FIT and also conventional psychomotor tests of alertness, balance and co-ordination, revealed a surprising percentage of individuals were unable to perform FIT satisfacorily despite being known to have been drug free for a period of at least 8 hours prior to testing. These findings strongly support the hypothesis - **"FIT are not reliable or valid indicators of drug-related impairment in driving ability".**

In view of the findings of the research studies, an attempt has been made to develop a more appropriate and more sensitive clinical test battery or algorithm which would be more suitable and more reliable as a diagnostic indicator of drug-related impairment of driving. The proposed clinical test of impairment (CTI) battery is detailed fully in the General Discussion in Chapter 5.

CHAPTER 2. FIT Research Studies - methods and materials

This chapter wil explain why the research procedures were considered to be both worthwhile and important. The aims and objectives, methods, results, and conclusions drawn as the research projects developed will be fully described.

2.1. Background to UK Introduction of FIT - surveys 1 and 2.

In January 1998 the UK Department of Environment Transport and the Regions (DETR) published findings of the first 15 months of a 3 year study into the incidence of drugs in road accident fatalities DETR which revealed there had been a total of 619 road traffic fatalities in the U.K. and over 6% of these had tested positive for medicinal drugs, 18% for illicit drugs (mainly cannabis), and 34% for alcohol. Although the incidence of medicinal drugs had not significantly changed from the 1985 - 1987 study it was noticeable that illicit drug use had increased six fold in percentage terms from 3% to 18% (Tunbridge, Keigan and James (2001). These results provoked government concerns and stimulated initiatives in an attempt to counteract the problems posed by "drug-drivers".

Strathclyde Police in Scotland had however, previously taken the initiative and in 1997 had sent two officers to the United States to assess the training programmes for police officers in respect of the Drug Evaluation and Classification (DEC) programme and also the Drug Recognition Examiners (DREs) being used at that time in California. As a result of their experiences Fleming and Stewart (1998) produced a training package of Field Impairment Tests (FIT), which were in fact simply the Standardised Field Sobriety Tests (SFSTs) which had been used in California since the 1970s.

Following discussions between the Association of Chief Police Officers (ACPO) FIT became the subject of a trial throughout the Strathclyde region in Scotland and six police areas in England over a 15 month period from early 1999. Following analysis of this pilot, which was perceived to be a success, a training course was established for police officers and FMEs in respect of the formal introduction of FIT.

2.1.1. Overview of FIT – Initial demonstration and FME opinion.

In June 2000, following conclusion of the pilot and prior to the introduction of FIT, Strathclyde Police invited me as a senior FME of some 20 years experience to attend a demonstration of FIT performed by police officers. Also in attendance were senior police officers and Procurators Fiscal. Following a full demonstration of FIT by police officers, comments were invited from the attendees and it became immediately evident that the senior police officers and the fiscals present considered the tests to be eminently suitable and voiced their approval heartily.

The five components of FIT in the UK test battery are –

- Pupillary examination
- The Walk and turn test
- The One leg stand test
- The Romberg test
- The Finger to nose test.

Due partly to what I considered to be the over-complex nature of the tests and also to the rather stringent assessment of "clues" or "indicators" of impairment, I voiced my opinion regarding FIT which I considered to be unnecessarily difficult and physically onerous for certain individuals. I further advised that due to the complexity of the instructions given to the suspect drivers it was entirely likely that some individuals

might have difficulty in understanding and remembering the instructions, thereby limiting their chances of completing the tests in a satisfactory manner. However my concerns were promptly dismissed by the police demonstrators who advised that these tests had been developed in the U.S.A. by "experts". It was obvious to me that my concerns were not shared by any others and the consensus was that the proposed FIT was a welcome development to be used in the detection of "drug drivers".

2.1.2. Setting of FIT training day – Survey 1 and Preliminary hypothesis.

In October 2000 Strathclyde Police arranged a full day training session on FIT for FMEs and 31 doctors attended. I had anticipated this event to be an opportunity to canvass the opinion of my colleagues regarding the suitability of FIT and had printed a brief questionnaire for them to complete at the end of the session (Appendix B). The doctors were requested to indicate their level of experience and whether or not they held a postgraduate qualification in forensic medicine. Following a full demonstration of the tests the attendees were divided into small groups and each doctor was individually subjected to all aspects of FIT. The majority of doctors managed the tests satisfactorily however most groups had at least one participant who had difficulty with the procedures and performed poorly and displayed evidence of the "clues" or "indicators" of impairment. At the conclusion of the training, a plenary session was held which 25 FMEs attended and expressed their views and a "straw poll" conducted revealed that only a slight majority of the doctors were entirely happy with the proposed tests and a sizeable percentage of FMEs expressed reservations. This was confirmed by the responses in the completed questionnaires and these served to reassure me that although Strathclyde Police had dismissed my

concerns regarding FIT other experienced FMEs supported my opinion that FIT were not suitable as clinical tests of impairment of driving ability due to drugs.

It is not disputed that FIT are tests of balance, co-ordination and to an extent cognitive awareness, however my hypothesis was, and is, straightforward –

"FIT are not reliable or valid indicators of drug-related impairment of driving ability".

2.1.3. Postal questionnaire of FMEs in Strathclyde Police - survey 2.

As a result of the responses from the FMEs, I was reassured that I was not a "lone dissenter" in respect of my concerns regarding FIT and I was encouraged to seek the opinion of all FMEs in Strathclyde (n = 101) and who represented the overwhelming majority of FMEs in Scotland who numbered approximately 130 in total. I requested and received from Strathclyde Police, a postal listing for all FMEs and in November 2000 I posted identical questionnaires with a full description of the proposed FIT and a stamped addressed envelope, to all my colleagues in Strathclyde. This resulted in a reasonable if not entirely satisfactory response rate of 45%. I had, as before, asked the doctors to give their opinion on FIT, but also enquired as to their views on the "2nd examination" procedure used at that time for suspect drivers, and whether they felt an "Aggregate Clinical Score" might be of value. To further analyse the responses I asked, as previously, for the doctors to include any post-graduate qualifications held in forensic medicine, and finally to list their number of years experience as an FME.

The results received from this wider survey were similar to those of survey 1 and this encouraged me to canvass the opinion of FMEs nationwide in survey 3.

FIT QUESTIONNAIRE - STRATHCLYDE FMEs - SURVEYS 1 AND 2.

The purpose of this questionnaire is solely to gauge the consensus of opinion within the audience in respect of the above.

There are no right or wrong answers however each and every response is of value.

1. Do you consider the tests as outlined and recommended to us for adoption as standard procedures, are, or may be regarded as -

(i) more difficult than they need to be? YES / NO

(ii) more harshly or critically assessed than they ought to be? YES / NO

2. **Walk & Turn Test:** considering the test as outlined and the recommendation this test is adopted as a matter of routine, are you –

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

3. **One Leg Stand Test:** considering the test as outlined and the recommendation this test is adopted as a matter of routine, are you -

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

4. **Finger Nose Test:** considering the test as outlined and the recommendation this test is adopted as a matter of routine, are you –

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

5. **Romberg Test:** considering the test as outlined and the recommendation this test be adopted as a matter of routine, are you -

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

6. **Section 4 R.T.A. 2nd Examinations:** In previous years when a suspect driver was found to be impaired, Form F97 was completed with appropriate findings listed. The suspect driver was detained in custody for some 8 to 12 hours, then subsequently re-examined, almost always with the absence of previously noted signs of impairment.

Do you consider a second examination of suspect initially found impaired –

(i) Essential? YES / NO

(ii) Worthwhile? YES / NO

(iii) Worthless? YES / NO

(iv) Absolutely contra-indicated? YES / NO

7. **Overall Assessment of impairment / lack of impairment :**

Do you feel there would be any merit in developing and adopting a procedure whereby clinical signs which may be consistent with impairment due to drugs, are individually scored and aggregated, resulting in a grand total score for each suspect?

Low score = normal or no impairment.

Intermediate score = borderline or possible impairment.

High score = definite impairment.

Would you consider a clinical sign **aggregate score** system of value? YES/NO

How many years experience as a police surgeon do you have? 0 - 5 Years

6 - 10 Years

11 - 20 Years

20 + Years

Do you have a post grad qualification such as – D.M.J. ? YES / NO

D.F.M. ? YES / NO

Thank you for completing this questionnaire.

2.2. Research project 3 – Aims and objectives.

The purpose of the survey was to gain as widespread a view as possible of FMEs working throughout the UK in respect of their opinion on the suitability of FIT as appropriate or reliable indicators of impairment of driving ability due drugs.

2.2.1. Research project 3 - methods and materials.

Following approval from the Education and Research committee of the Association of Police Surgeons (APS) I contacted the secretary of the APS and received a full mailing list of all registered police surgeons / FMEs. With the benefit of financial assistance from the W.G. Johnston Memorial Trust Fund to cover printing and postage costs, I produced 960 questionnaires and posted these with enclosed stamp addressed envelopes to all members of the APS on the current mailing list.

2.2.2. Modified design of survey 3.

The questionnaire was re-designed in order to eliminate any possible question of bias, subliminal or otherwise, which was present in the initial two surveys. The FMEs were posed questions in respect of various aspects of FIT and asked to give their opinion not simply as a YES / NO response, however were invited to give their opinion in one of five possible responses as follows – much too easy; too easy; about right; too difficult; much too difficult. The FMEs thus had a far greater range of response and were obviously not restricted to a simple YES /NO response, and this eliminated any question of potential bias in the questionnaire. As before the FMEs

were invited to provide comments on the tests in general and were asked specifically to give their opinion on the value of an "aggregate clinical score" and the potential benefit, if any, in a 2nd examination of suspect drivers.

2.2.3. Timescale of survey 3.

The questionnaires were posted in August 2002 and responses received between September and November 2002. Data was collected and analysed with the results submitted in time for a presentation to the 30th Annual Conference of the Association of Police Surgeons of Great Britain in May 2003.

2.2.4. Results of survey 3.

The surveys undertaken show that whilst the majority of FMEs felt that FIT were "about right" a significant percentage of well qualified and experienced doctors felt that FIT were too difficult and a small number felt that FIT were entirely unsuitable. It was also clear that the doctors with less experience were most satisfied with the tests whereas more experienced doctors had expressed concerns about FIT.

2.2.5. Statistical Analysis of Survey 3.

All appropriate responses were collated and a basic preliminary analysis of the results was conducted. I received specialist help from Dr Linda Williams, Centre for Population Health Sciences, University of Edinburgh, who conducted detailed statistical analysis of the responses.

2.2.6. Hypothesis and questions in relation to surveys 1, 2 and 3.

My principal hypothesis is that FIT are not reliable or valid indicators of drug-related impairment in driving ability. It is my submission that I am not a lone dissenter in this respect and having received evidence of other experienced FMEs' concerns in relation to FIT, my questions are –

1. Can FIT reliably detect and identify evidence of recent drug use in subjects?
2. Can FIT be accepted as a reliable and valid indicator of drug-related impairment in driving ability?

2.3. Research study groups A, B and C – overview, hypothesis and questions.

Since my main hypothesis - which is that FIT are not reliable or valid indicators of drug-related impairment of driving ability - needed to be tested, it was my intention to apply FIT to specially selected groups known to be drug-free at the time of assessment to discover how these groups performed.

This work is important because although there have been several studies in which subjects have been given measured doses of specific drugs and then subjected to FIT, no studies have been published in respect of FIT being applied to subjects known to be drug-free at the time of the assessment.

The questions I wish to address in these specific study groups are –

1. How do "normal" drug-free individuals perform on FIT?
2. What percentage, if any, of drug-free individuals perform poorly on FIT?
3. Which test(s), if any, cause difficulty in drug free subjects?
4. Are FIT reliable and valid indicators of drug-related impairment in driving?

2.3.1. Design of research studies

I purposely selected my three specific study groups from persons who had been detained in custody for a period of at least 8 hours. My reasons were two-fold –

(i) I wished to be certain that the subjects had taken no drugs in the previous 8 hours.

(ii) These particular core groups are similar in age and socio-economic background to persons regularly stopped by police as suspected of driving under the influence of drugs and required by police to participate in FIT.

2.3.2. Ethical approval.

Ethical approval was not required for these particular studies since all data used in the research was extracted from clinical records, which were reviewed following normal and routine audit of my clinical practice for the examination of detained prisoners. Prior to examination of all detainees it is, and always has been, my practice to receive valid and fully informed consent from the detainees who are of course my patients at the time of the examination. The clinical notes are retained in a confidential Forensic Medical Examination book however notwithstanding this, the patients have been anonymised and identifiable only by age and study number.

2.3.3. Study settings.

All subjects were examined within the confines of the medical examination suites of Strathclyde Police in "Q" division following their specific request to be seen and treated by a doctor. The examinations took place in Strathclyde Police Offices in

Hamilton, East Kilbride and Rutherglen which are situated in South Lanarkshire in Scotland and which cover a population of approximately 300,000.

2.3.4. Time course of research studies.

The study process was particularly long due to the slow progress made in the selection of suitable subjects who had been detained for 8 hours prior to the clinical examination. The study began in April 2007 and concluded in November 2011.

2.3.5. Method of subject recruitment - Inclusion criteria.

Subjects were selected from detained prisoners who had requested medical attention. All detainees were known to have been in custody for at least 8 hours prior to the examination and this was confirmed by simply checking their custody records. They were selected and included into three distinct groups –

Group A. Detainees who claimed to be "in withdrawal" from the effects of illicit heroin abuse and had requested medication for relief of their symptoms.

Group B. Detainees who were in receipt of legally prescribed methadone and who required thorough medical assessment prior to administration of their methadone.

Group C. Detainees who requested medical attention but denied drug use.

2.3.6. Exclusion criteria.

I excluded all detainees who appeared to be suffering from any of the following –

- Intoxication due to alcohol
- Intoxication due to drugs
- Any acute physical injury
- Any chronic locomotor disability
- Any neurological condition
- Any acute psychiatric disorder
- Any acute medical problems
- Any significant chronic health problems

2.3.7. Clinical assessment and data collection.

The clinical examinations conducted were thorough and incorporated the standard elements of clinical examination including – consent; history of presenting complaint; past medical history; recent health; drug history - both prescribed and illicit; clinical examination; diagnosis; treatment; and continuation of care plan. All patients were anonymised and identified by number and age.

A detailed medical history was taken in order to ensure the absence of any exclusion criteria. The subjects were examined for evidence of recent injury and any significant deformities or abnormalities. The general appearance and demeanour of the patient was noted, and the conscious level and mental state was assessed. Clinical examination included an assessment of the speech in both manner and content. A cardiovascular assessment was performed with pulse, blood pressure and heart rate recorded and the skin was examined for colour, temperature and sweating. The eyes were examined in detail with specific reference to pupil size and reaction to light;

hyperaemia (bloodshot); nystagmus (flickering lateral eye movements or lack of smooth lateral eye movement); and lack of convergence. Reflexes and simple reaction time were assessed. FIT was conducted and finally a straightforward simple memory test was performed. A diagnosis was made in respect of the subject's general condition and fitness for detention. Medical treatment by way of drug therapy, if necessary, was given and clear instructions for regular administration of medications were left with custody staff. Finally advice regarding the regularity of observations of the detainee was left in writing and signed, timed and dated.

During the research study period I examined in excess of 2,000 detainees who claimed either addiction to heroin or receipt of legally prescribed methadone and the subjects chosen for this research represent a convenience sample. My personal experience, which is shared by the Faculty of Forensic and Legal Medicine, is that many drug dependent detainees who are addicted to heroin claim to be suffering from "withdrawals" immediately after their arrest and request urgent medical treatment. A difficulty facing the FME is that it is impossible for the clinician to know what substances the detainee might have taken immediately prior to their arrest, and such substances may not illustrate any immediate clinical effects. It can be a difficult clinical judgement to make regarding the level of drug substitution therapy, which would be both appropriate and safe to administer to the detainee. Many experienced FMEs regard it prudent to delay examination and treatment in these particular groups of patients for approximately 6 to 8 hours, to allow for a natural "drying out" period to minimise contamination from drugs used prior to arrest. It was for this specific reason that the 8 hour interval from arrest was chosen.

It is important to acknowledge that despite being in custody for a period of 8 hours it is not possible to be certain that the detainees have not secreted drugs in a body cavity such as the rectum and have ingested psychoactive substances subsequent to their detention since body searches, when conducted by police and force support officers, involve only a visual inspection of the buttocks and anus, as opposed to an intimate body search involving examination of body cavities conducted by an FME in a hospital setting with full medical support and resuscitative facilities.

Thorough handwritten medical records of all detainees examined in custody, whether included in the study or not, are recorded in the "Police Surgeon's Examination Book" dated and timed at the individual examination and held by the Custody Officer. These records are essential to illustrate that an appropriate standard of medical care has been provided to the detainee, and also for any potential evidential purpose. These records were used to prospectively populate the database for this research, and in addition the patients gave their fully informed valid consent for the examination process, which is obtained as a matter of routine and normal procedure.

The research subjects were allocated to group A, B or C depending on the nature of their request for medical care. Each of the subjects in each group was assessed by three separate methods -

1) In strict accord with FIT procedures and using "clues" or "indicators" of impairment
2) Using FIT but without reference to "clues" or "indicators"
3) Using "standard" or conventional psychometric tests

The data from the clinical assessments was collected and recorded in a standard Microsoft Excel package with each subject identified sequentially by number.

Assessments were made on the basis of whether each subject could perform the tests satisfactorily – either YES or NO, and by the three separate methods. A satisfactory performance was marked YES and scored 1 whereas an unsatisfactory performance was marked NO was scored 0 in each individual case. I collected the gross scores for each group and sub-group and noted these results.

2.3.8. Statistical analysis.

All results were collated and I conducted a basic preliminary analysis of the results. I received specialist help from Dr Linda Williams, Centre for Population Health Sciences, University of Edinburgh who conducted a detailed statistical analysis of the responses of the subjects of all groups.

CHAPTER 3. Field Impairment Tests - Fit for purpose? Evidence from FMEs.

3.1. Survey 1 – A survey of FMEs attending FIT training day.

The objective of this small-scale survey was to determine the opinion of forensic medical examiners (FMEs) within Strathclyde Police who had attended a full day training session on Field Impairment Tests (FIT) in suspected drug-impaired drivers. 31 FMEs attended the course and 25 FMEs remained for the final plenary session.

3.1.1. Material and methods.

The 25 FMEs who attended a full-day training programme and plenary session in respect of "Drugs and Driving and Impairment Tests" were asked to complete a questionnaire relating to the tests (2.1.3. and Appendix B). The doctors were asked demographic questions about their length of experience as FMEs; whether they held a postgraduate qualification in forensic medicine; and to indicate their level of satisfaction with the proposed FIT.

The FMEs were essentially asked if they approved of the tests in general -

Question 1. Are you happy to accept the tests as recommended? YES / NO

Question2. Are the tests more difficult than they need to be? YES / NO

Question 3. Are the tests more harshly assessed than they need be? YES / NO

They were asked to consider each test individually. Finally the doctors were asked to indicate whether or not they approved of –

(1) **A 2nd examination** several hours after the first examination for the purpose of comparing any change in performance, if detected (Appendix B Question 6).

(2) **An Aggregate Clinical Score**, which might quantify the degree of clinical signs (Appendix B Question 7).

3.1.2. Survey results and analysis.

Of the 31 conference attendees, 25 FMEs completed the questionnaire with the responses recorded in tables 3.1 and 3.2.

Question 1. In respect of whether the FMEs approved of the tests in general, 54% (n = 14) declared themselves happy to accept the tests, with 46% (n = 11) stating the tests were either too difficult and/or too harshly assessed. the Walk and Turn test had 48% (n = 12) approval and 52% (n = 13) dissent. The One Leg Stand test had 44% (n = 11) approval and 56% (n = 14) dissent. The Finger Nose test had 64% (n = 16) approval and 36% (n = 9) dissent. Similarly the Romberg test had 64% (n = 16) approval and 36% (n = 9) dissent.

Question 2. In respect of the question whether or not the FMEs considered the tests more difficult than necessary, none of the 56% (n = 14) who had approved the tests considered them too difficult, whereas all 44% (n = 11) who had not approved the tests stated they were more difficult than necessary.

Question 3. In respect of the question whether or not the FMEs considered the tests more harshly assessed than necessary, none of the 56% (n = 14) who had approved the tests considered them too harshly assessed, whereas all 44% (n = 11) who had not approved the tests stated they were more harshly assessed than necessary.

A 2nd examination procedure found favour with 96% (n = 24) with no support in 4% (n = 1). An "aggregate clinical score" system for a suspect driver was thought to be of value in 84% (n = 21) with 16% 9n = 4) regarding this concept as worthless.

These responses were analysed further by virtue of assessing responses from doctors holding recognised qualifications in forensic medicine such as the diploma in Medical Jurisprudence (DMJ) or the diploma in Forensic Medicine (DFM) and comparing them to those of doctors without such qualifications.

(i) Doctors without post graduate forensic qualifications (14)

71% (n = 10) of doctors approved of FIT with 29% (n = 4) expressing reservations.

The **Walk and Turn** test had 50% (n = 7) approval and 50% (n = 7) dissent.

The **One Leg Stand** test had 50% (n = 7) approval and 50% (n = 7) dissent.

The **Finger Nose** test had 71% (n = 10) approval with 29% (n = 4) dissent.

The **Romberg** test had 79% (n = 11) approval and 21% (n = 4) dissent.

A 2nd examination found favour in 100% (n = 14) with no dissenters.

An "aggregate clinical score" was thought to be of value in 86% (n = 12) with 14% (n = 2) regarding it worthless.

(ii) Doctors with post graduate forensic qualifications (11)

36% (n = 4) of doctors approved of FIT with 64% (n = 7) expressing reservations.

The **Walk and Turn** test had 36% (n = 4) approval and 64% (n = 7) dissent.

The **One Leg Stand** test had 27% (n = 3) approval and 73% (n = 8) dissent.

The **Finger Nose** test had 64% (n = 7) approval with 36% (n = 4) dissent.

The **Romberg** test had 45% (n = 5) approval and 55% (n = 6) dissent.

A **2nd examination** found favour in 91% (n = 10) with 9% (n = 1) dissent.

An **aggregate clinical score** was thought to be of value in 73% (n = 8) with 27% (n = 3) regarding it worthless.

Table 3.1. Survey 1. All responses received from FMEs.

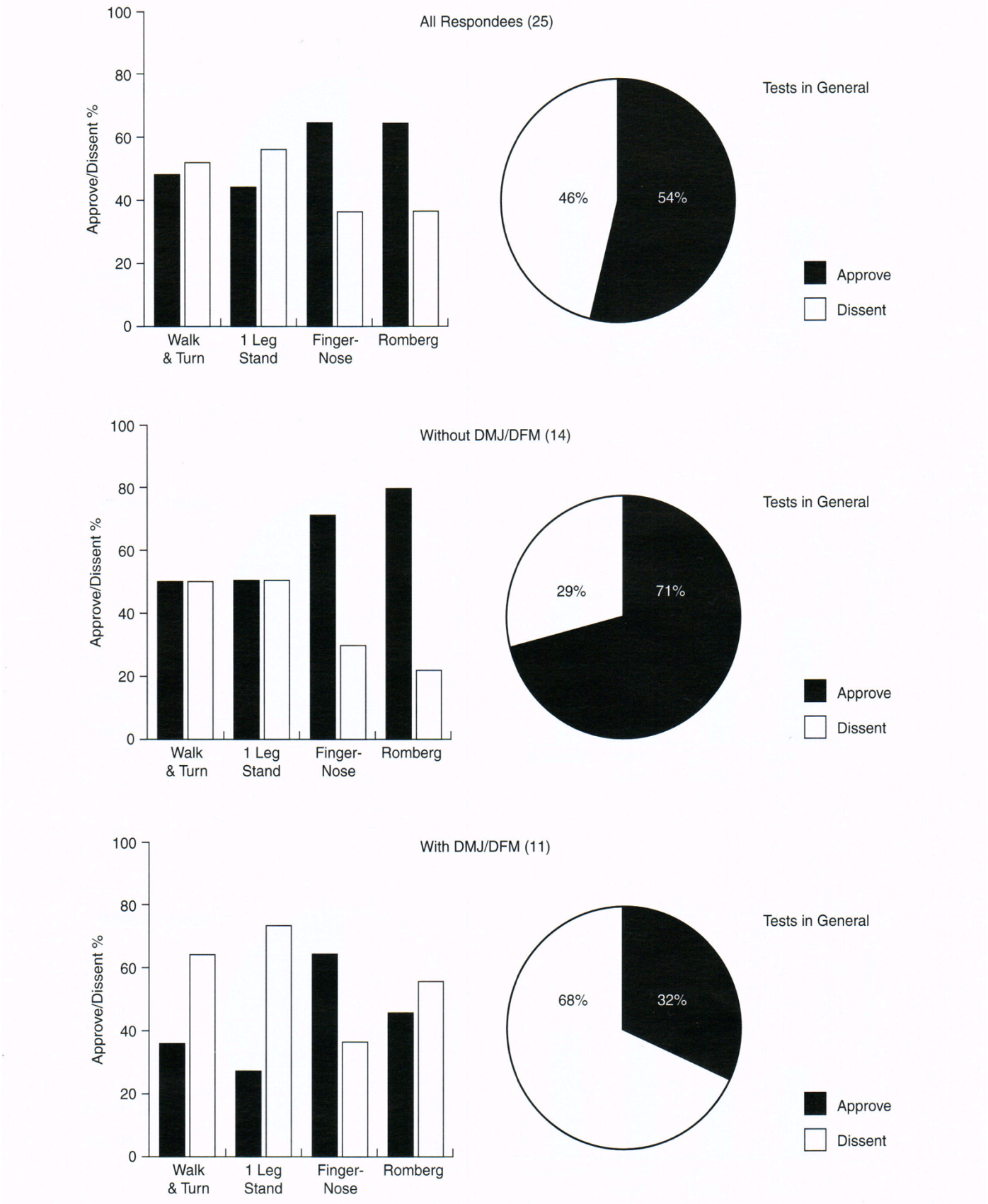
	All responses (n = 25)	Without DMJ/DFM (n = 14)	With DMJ/DFM (n = 11)
Approval rate			
Tests in general	54% (n =14)	71% (n = 10)	36% (n = 4)
Walk & Turn	48% (n = 12)	50% (n = 7)	36% (n = 4)
One Leg Stand	44% (n = 11)	50% (n = 7)	27% (n = 3)
Finger - Nose	64% (n = 16)	71% (n = 10)	64% (n = 7)
Romberg	64% (n = 16)	79% (n = 11)	45% (n = 5)
2nd Examination	96% (n = 24)	100% (n = 14)	91% (n = 10)
Aggregate score	84% (n = 21)	86% (n = 12)	73% (n = 8)

The responses were further analysed by assessing the responses from doctors split into groups depending on length of experience as practising police surgeons – less than 5 years; 6 to 10 years; 11 to 20 years; and 20 years plus. It is acknowledged however that increasing length of experience does not always correlate directly to increasing familiarity with examination of suspect "drug drivers" or indeed FIT.

Table 3.2. Survey 1.Responses received from FMEs by experience.

	0 – 5 years (n = 3)	6 – 10 years (n = 7)	11 – 20 years (n = 10)	20 years plus (n = 5)
Approval rate				
Tests in general	67% (n = 2)	43% (n = 3)	50% (n = 5)	60% (n = 3)
Walk & Turn	100% (n = 3)	43% (n = 3)	50% (n = 5)	40% (n = 2)
One Leg Stand	67% (n = 3)	43% (n = 3)	50% (n = 5)	40% (n= 2)
Finger - Nose	100% (n = 3)	71% (n = 5)	70% (n = 7)	60% (n = 3)
Romberg	100% (n = 3)	86% (n = 6)	60% (n = 6)	60% (n = 3)
2nd Exam.	100% (n = 3)	86% (n = 6)	90% (n = 9)	100% (n = 5)
Aggregate	67% (n = 2)	57% (n = 4)	80% (n = 8)	100% (n = 5)

Figure 3.1. Conference responses - survey 1.



3.1.3. Summary and conclusions.

The survey findings clearly indicated that only a slight majority of FMEs who had attended the training session and undertook FIT personally were content to fully accept FIT as proposed. The notable findings from this brief survey were –

1. A significant percentage (46% n = 14) of FMEs did not approve FIT.
2. A majority of FMEs (52% n = 13) disapproved of the Walk & Turn test.
3. A majority of FMEs (56% n = 14) disapproved of the One Leg Stand test.
4. FMEs with least experience showed highest level of approval for FIT.
5. The majority of FMEs with postgraduate qualifications in forensic medicine disapproved of FIT (64% n = 7) whwereas the majority of FMEs without postgrad. qualifications (71% n = 10) approved of FIT.
6. A "2nd Examination" was approved by a majority (96% n =24) of FMEs.
7. An "Aggregate Clinical Score" also received high (84% n = 21) approval.

3.1.4. Limitations of survey 1.

The main limitations of this survey were the low sample size of only 25 subjects, particularly the FMEs who had less than 5 years experience (n = 3), and the specific wording of the questionnaire. However although the number of FMEs surveyed was small, this survey group had the benefit of being experienced forensic medical examiners who regularly examined suspect drivers and were entirely familiar with this process, but perhaps more importantly they had "first-hand" experience of FIT since they had all personally been subjected to FIT during the intensive training session.

The specific wording of the questionnaire might reasonably be subject to criticism since the FMEs were invited only to give their opinion on whether they considered the tests "too difficult" or the assessment of FIT "too harsh", when in the interest of fairness, they should also have been invited to state whether or not they considered the tests or the assessments "too easy" or not. This would have eliminated the question of any bias in the questionnaire, subliminal or otherwise. It is also accepted that the question regarding "approval" has the potential to bias the results.

An explanation, which to an extent, might account for these shortcomings is that the training session and conference was arranged with little advanced notice given to the FMEs and the questionnaire was prepared in haste.

3.2. Survey 2 - A survey of all Strathclyde Police FMEs.

The principal objective was to ascertain the opinion of FMEs working throughout the Strathclyde region in Scotland regarding FIT. This survey offered the possibility to canvass the opinion of a larger number of FMEs (n = 101) and compare their responses with those of survey 1. This survey was undertaken only a matter of two weeks after survey 1, and prior to me having any discussion regarding the findings with my experineced colleagues in other areas of the United Kingdom. Having composed the questionnaire personally, I was unaware of the limitations of the wording of the initial survey and replicated it exactly in survey 2 such that the wider study might be analysed and the results compared on a "like for like" basis with the results of survey 1.

3.2.1. Material and methods.

The Police Surgeon Co-ordinator of Strathclyde Police was approached and given a full explanation of the proposed questionnaire survey and the reasons for undertaking the project. After a detailed discussion and following the specific request, the names and addresses of all FMEs who provided forensic medical services to Strathclyde Police were released.

An identical questionnaire to that of survey 1 (see 2.1.3. and Appendix B), and a stamped addressed envelope was posted to all 101 FMEs on the Strathclyde Police database.

As before, the doctors were asked demographic questions about their length of experience as FMEs; whether they held a postgraduate qualification in forensic medicine.

Again the FMEs were asked identical questions to those detailed in section 3.1.1.

3.2.2. Survey 2 – results and analysis.

The survey yielded a moderate 45% response rate (n = 45) and the results were analysed in a similar manner to survey 1. The results of this survey were very similar to those of survey 1 with 52% (n = 23) declaring their approval of the tests in general, as compared to 54% (n = 14) of respondees in survey 1 (Table 3.3).

It is acknowledged that, as for survey 1, this was a qualitative analysis as opposed to a quantitative analysis.

Question 1. The findings were intriguing and somewhat anomalous in that although a very small majority 52% (n = 23) of the FMEs stated their approval of the tests in general, when they considered each test individually no single tests at all was approved by the majority of respondees. The Walk and Turn test and the One Leg Stand test had identical and low levels of approval of 35% (n = 16), whereas the Romberg and Finger Nose tests found a higher level of approval of 47% (n = 21) and 49% (n = 22) respectively.

Question 2. In respect of the question whether or not the FMEs considered the tests more difficult than necessary, once again the findings were somewhat contradictory in that 8 of the 23 FMEs who stated their approval of the tests felt at least one of the tests was too difficult and 6 of the 23 FMEs felt two tests were too difficult. Less surprisingly, all FMEs who disapproved of the tests considered both the One Leg Stand and the Walk and Turn tests too difficult.

Question 3. In respect of the question whether or not the FMEs considered the tests more harshly assessed than necessary, the 8 FMEs who had approved the tests in general but had considered at least one test too difficult, had also considered them too harshly assessed. whereas all FMEs who had not approved of the tests stated they were more harshly assessed than necessary.

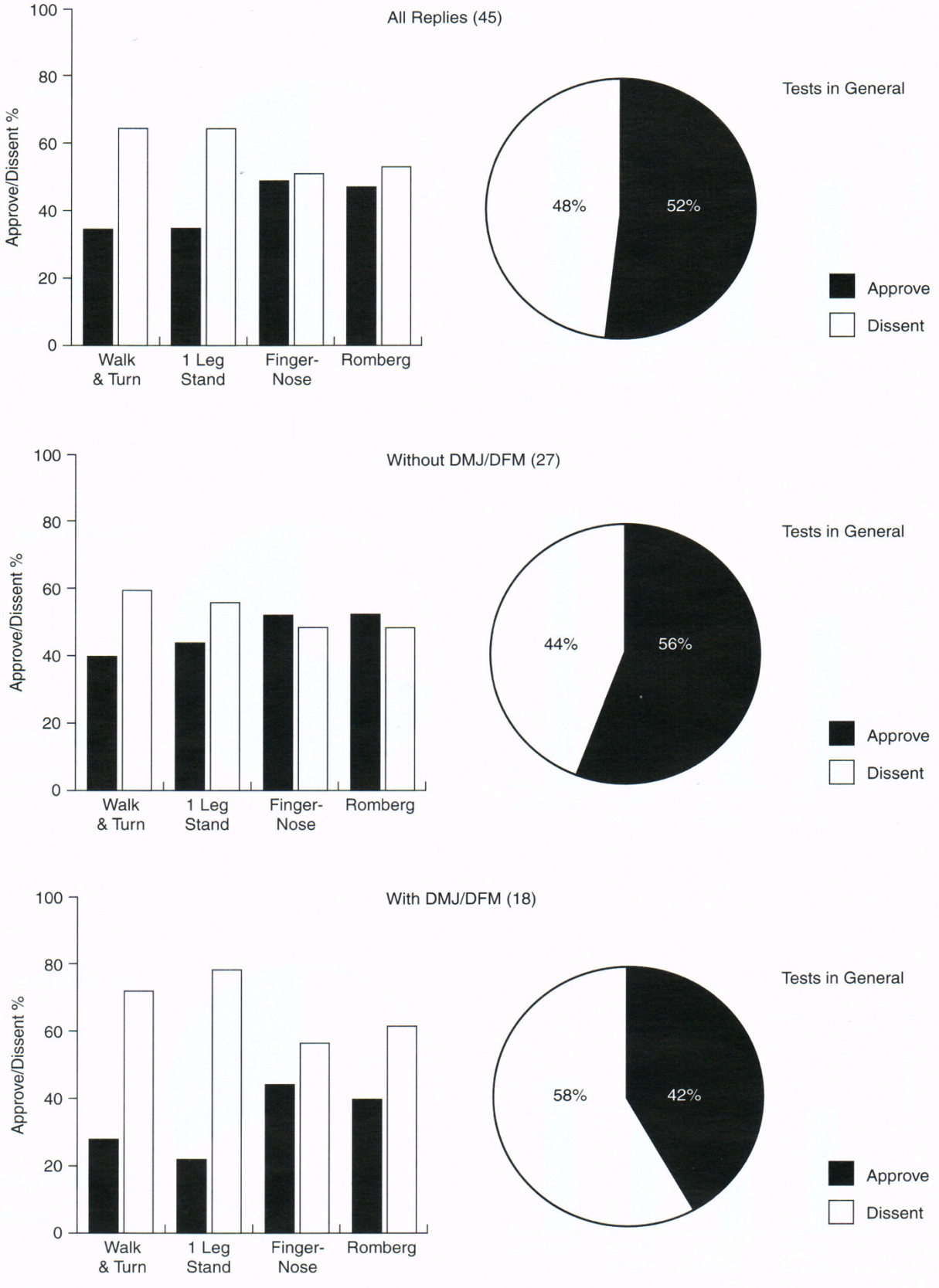
A 2nd examination procedure found favour with 87% (n = 39) of postal respondees and an "Aggregate Clinical Score" system for a suspect driver was thought to be of value in 78% (n = 35).

As before, the responses were analysed further by virtue of assessing responses from doctors holding recognised qualifications in forensic medicine such as the diploma in Medical Jurisprudence (DMJ) or the diploma in Forensic Medicine (DFM) and comparing them to those of doctors without postgraduate qualifications.

Table 3.3. Survey 2. All responses received from FMEs.

	All responses (n = 45)	**Without DMJ/DFM (n = 27)**	**With DMJ/DFM (n = 18)**
Approval rate			
Tests in general	52% (n =23)	55% (n = 15)	42% (n = 8)
Walk & Turn	35% (n = 16)	40% (n = 11)	28% (n = 5)
One Leg Stand	35% (n = 16)	44% (n = 12)	22% (n = 4)
Finger - Nose	49% (n = 22)	52% (n = 14)	44% (n = 8)
Romberg	47% (n = 21)	52% (n = 14)	39% (n = 7)
2nd Examination	91% (n = 41)	89% (n = 24)	94% (n = 17)
Aggregate score	75% (n = 34)	74% (n = 20)	78% (n = 14)

Figure 3.2. Postal responses Strathclyde FMEs - survey 2.



3.2.3. Survey 2 – summary and conclusions.

Several findings were clearly noted:

(1) The responses from FMEs in survey 2 were similar to those of survey 1.

(2) Only a very slight majority of FMEs (52% n = 23) approved of the tests whereas 48% considered them either too difficult or too harshly assessed.

(3) More than 50% of all FMEs had concerns in every test, with 67% (n = 30) of FMEs expressing concern with Walk & Turn and 1 Leg Stand Tests.

(4) FMEs who held a post-graduate qualification in forensic medicine had a lower approval rate for FIT (42% n = 19) compared to FMEs who had no post-graduate qualifications and approved tests (56% n = 25).

(5) The majority of FMEs with post-graduate qualifications (58% n = 10) disapproved of the tests with the One Leg Stand test being criticised by 78% (n = 14) and the Walk and Turn test criticised by 72% (n = 13).

(6) The proposal of a 2nd examination of suspect drivers was considered to be of value by an overwhelming majority (91% n = 41) of all FMEs.

(7) An "Aggregate Clinical Score" was also approved by a large majority (75% n = 34) of all FMEs.

3.2.4. Limitations of survey 2.

This survey was conducted very shortly after survey 1 was completed and similar criticism may be levelled due to the small number of responses analysed as a result of the poor response rate of FMEs who completed and returned the questionnaire. Since the questionnaire was identical in format to survey 1, yet again the specific wording might be perceived to have had an underlying though unintentional bias.

3.3. Survey 3 - A survey of the Association of Police Surgeons (APS).

This was a major survey of 960 FMEs who were members of the Association of Police Surgeons of Great Britain and who provided forensic medical services to all police forces throughout the UK.

The aims and objectives of the study were as outlined below -

1) To discover the opinion of FMEs in relation to FIT in general.
2) To gauge overall opinion as to how difficult or easy the FMEs considered FIT to be for suspect drivers.
3) To consider the degree of difficulty in each of the 4 tests.
4) To gauge opinion regarding the "indicators" or "clues".
5) To assess opinion as to the value of an "aggregate clinical score".
6) To receive specific comments relating to FIT.

3.3.1. Materials and methods.

A postal survey was conducted among 960 registered members of the Association of Police Surgeons of Great Britain with a view to canvassing their opinion of FIT. Of the 960 questionnaires circulated to members of APS, 539 were returned, yielding a 56.2% response rate. Of these, 159 responses were excluded since the FMEs were not regularly involved in general police work due to their status as - Sexual Offence Examiners (n = 57); retired (n = 57); "unknown at current address" (n = 16); resigned (n = 15); forensic odontologists (n = 5); forensic pathologists (n = 3); infrequent practice (n = 3), deceased (n = 3). This resulted in 380 doctors who were regularly involved in the examination of suspect "drug-drivers" who completed the questionnaire and whose responses were analysed in detail.

The doctors were asked to indicate their level of experience according to the following groups; 0 - 5 years; 6 - 10 years; 11 - 20 years; and 20 plus years. They were asked to indicate whether or not they held a postgraduate qualification in forensic medicine such as the Diploma in Medical Jurisprudence or the Diploma in Forensic Medicine (Table 3.4). The doctors were asked how difficult they considered the impairment tests to be for the arrested drivers to perform (Table 3.5). They were also asked their opinion of the standards for assessing the tests, i.e. the criteria or "clues" which might indicate impairment (Table 3.7). The doctors were asked to consider each test individually, such that any significant variations, if found, could be related to individual tests (Tables 3.9; 3.11; 3.13; 3.15). Finally the doctors were asked their opinion of an "Aggregate Clinical Score" in relation to the clinical findings (Table 3.17) and were invited to offer any further comments.

In order to address the limitations of the previous surveys the format of the questions was changed. The FMEs were invited to encircle one of the following responses –

much too easy; too easy; about right; too difficult; much too difficult

Completed questionnaires were received from the following groups –

Table 3.4. Survey 3. Responses received from all FMEs.

Years experience	With DMJ/DFM.	Without DMJ/DFM	Total
0 to 5 years	9	50	59
6 to 10 years	30	72	102
11 to 20 years	41	99	140
20 plus years	28	51	79

3.3.2. Survey 3 - results and analysis.

Table 3.5. Question 1. How difficult are the tests in general are for drivers to perform?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
374/380	1	16	234	116	7
98.4%	0.3%	4.3%	62.6%	31%	1.9%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 -5 (n = 59)	0	6 (10%)	43 (72.9%)	10 (16.9%)	0
6 -10 (n = 101)	0	3 (3%)	67 (66.3%)	29 (28.7%)	2 (2%)
11- 20 (n = 136)	0	5 (3.7%)	82 (60.3%)	45 (33.1%)	4 (2.9%)
20 plus (n = 78)	1 (1.3%)	2 (2.6%)	42 (53.8%)	32 (41%)	1 (1.3%)

Figure 3.3. Question 1. All FME responses.

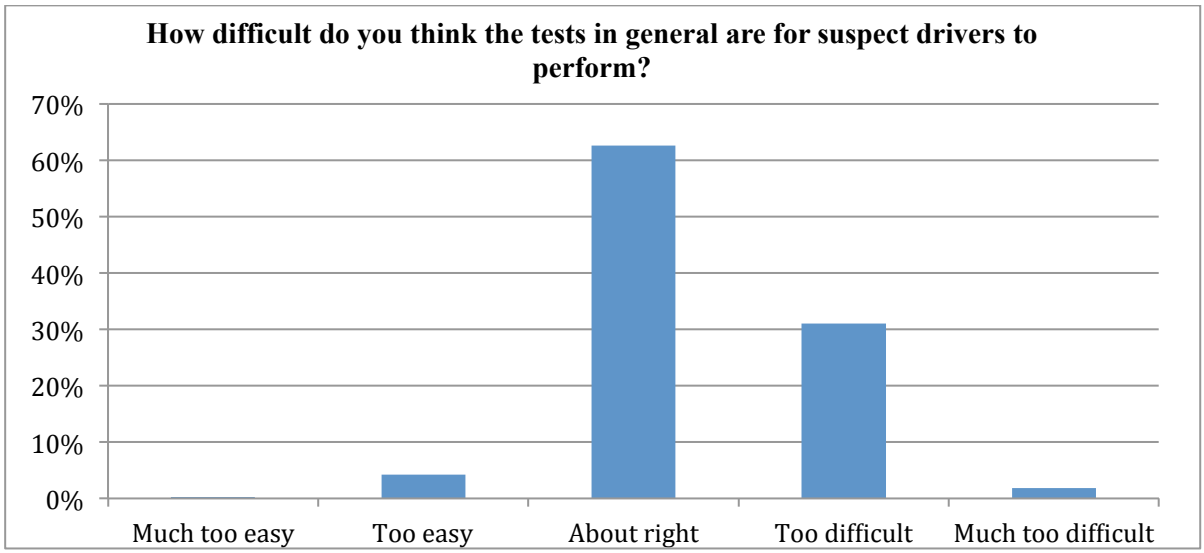
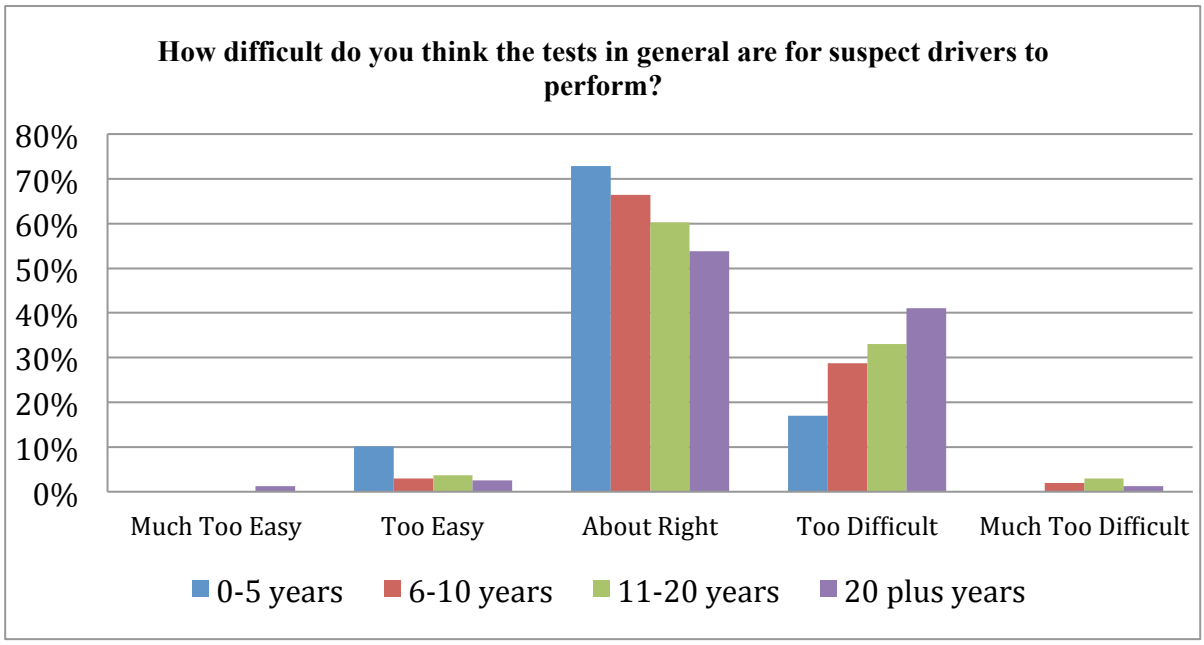


Figure 3.4 Question 1. Responses by years of experience.



Question 1: FME Responses - overall.

The 'about right' category of response has been excluded as being uninformative, and the balance of responses on either side has been investigated. It is found then that there is a statistically significant lean towards 'too difficult' (including 'much too difficult') when compared with 'too easy' (including 'much too easy'). These categories have been collapsed together due to very small numbers in the 'much too' categories. Thus, there is 17 in one category and 123 in the other. On the assumption of a binomial distribution with an expected event probability of 0.5, the chance of randomly dividing 140 people into two groups and ending up with 17 in one and 123 in another is exceedingly small ($p<0.0001$).

Table 3.6. Question 1: FME responses - By experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		response			
		too easy	about right	too hard	Total
experience	0-5 years	6	43	10	59
	6-10 years	3	67	31	101
	11-20 years	5	82	49	136
	20+ years	3	42	33	78
Total		17	234	123	374

Table 3.6 shows that by simple χ^2 test of association, there is evidence to suggest that the distribution of responses is not independent of experience ($p=0.025$). However, if the χ^2 test is applied for trend, where it is suspected that there is a linear relationship between response and experience, then $p=0.001$.

Looking at table 3.6, it would appear that less experienced responders are more likely to choose 'too easy' or 'about right', while the most experienced are more likely to choose 'too hard'. To demonstrate this effect, taking the proportion of 'too hard' in each experience group, we get 17%, 31%, 36% and 42% of responders in each experience group choosing 'too hard'.

Table 3.7. Question 2. What is your opinion of the standards for assessing the tests?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
368/380	3	23	221	110	11
96.8%	0.8%	6.3%	60%	30%	3%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 -5 (n = 58)	0	3 (5.2%)	41 (70.7%)	14 (24.1%)	0
6 – 10 (n = 101)	0	8 (7.9%)	63 (62.4%)	26 (25.7%)	4 (4%)
11 - 20 (n = 134)	1 (0.7%)	9 (6.7%)	78 (58.1%)	42 (31.3%)	4 (2.9%)
20 plus (n = 75)	2 (2.7%)	3 (4%)	39 (52%)	28 (37.3%)	3 (4%)

Figure 3.5. Question 2. All FME responses.

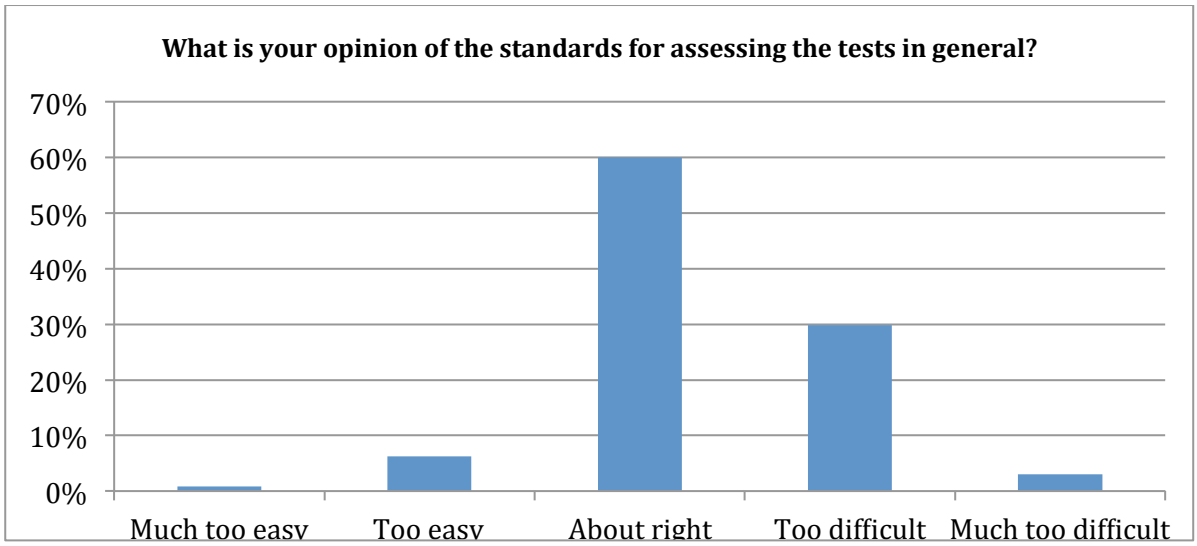
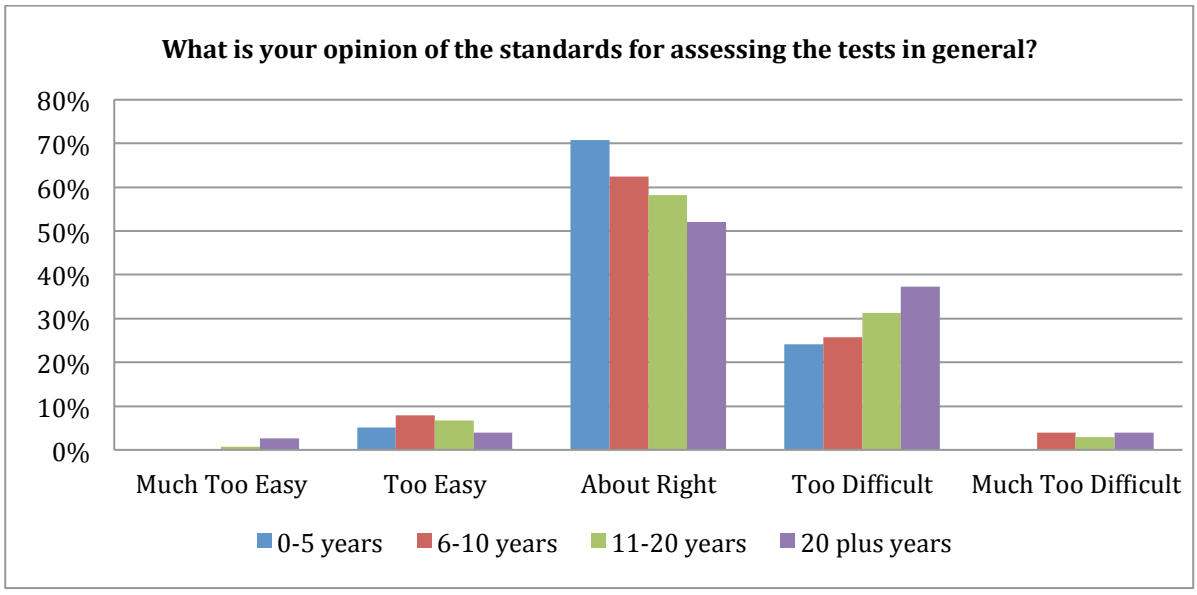


Figure 3.6. Question 2. Responses by years of experience.



Question 2: FME responses - overall.

As with the question 1 the 'about right' category has been disregarded as uninformative and the responses either side have been analysed. It is found again that there is a statistically significant lean towards 'too difficult' (including 'much too difficult') when compared with 'too easy' (including 'much too easy') with the group numbers being 26 versus 121, which is a statistical imbalance on the assumption of equality ($p<0.0001$).

Table 3.8. Question 2: FME responses - by experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		response			
		too easy	about right	too hard	Total
experience	0-5 years	3	41	14	58
	6-10 years	8	63	30	101
	11-20 years	10	78	46	134
	20+ years	5	39	31	75
Total		26	221	121	368

Table 3.8 shows by both χ^2 test of association ($p=0.44$) and χ^2 test for trend ($p=0.09$), there is no evidence to suggest that there is a significant association between experience and response.

Table 3.9. Question 3: What is your opinion of the Walk & Turn Test?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
379/380	3	24	221	122	9
99.2%	0.8%	6.4%	58.1%	32.4%	2.4%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 - 5 (n = 59)	2 (3.4%)	5 (8.5%)	35 (59.3%)	16 (27.1%)	1 (1.7%)
6 -10 (n = 102)	0	5 (4.9%)	69 (67.6%)	25 (24.5%)	3 (2.9%)
11-20 (n = 140)	0	7 (5%)	81 (57.9%)	50 (35.7%)	2 (1.4%)
20 plus (n = 78)	1 (1.3%)	7 (9%)	36 (46.2%)	31 (39.7%)	3 (3.8%)

Figure 3.7. Question 3. All FME responses.

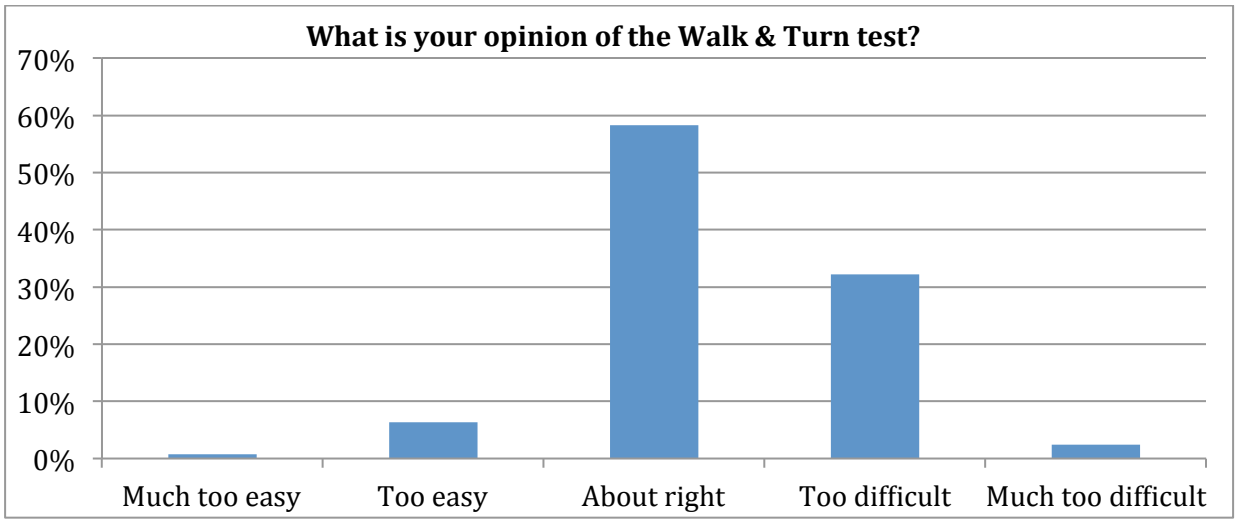
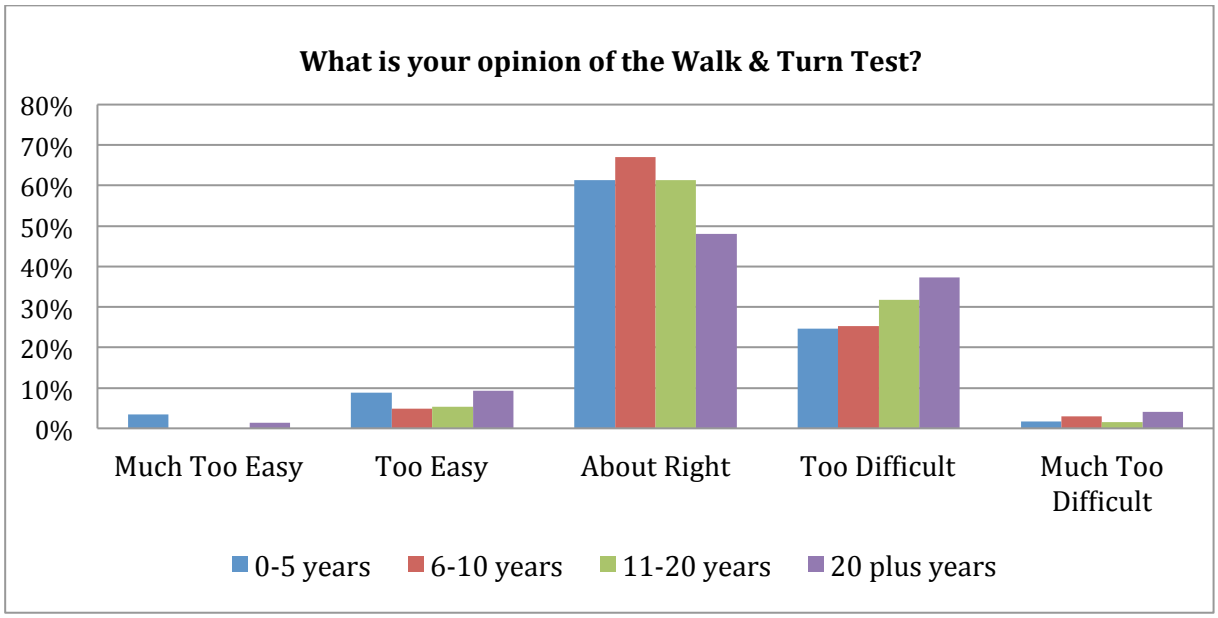


Figure 3.8. Question 3. Responses by years of experience.



Question 3: FME responses - overall.

As with the previous questions the 'about right' category has been disregarded as uninformative and the responses either side have been analysed. It is found again that there is a statistically significant lean towards 'too difficult' (including 'much too difficult') when compared with 'too easy' (including 'much too easy') with the group numbers being 27 versus 131, which is a statistical imbalance on the assumption of equality ($p<0.0001$).

Table 3.10. Question 3: FME responses – by experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		response			
		too easy	about right	too hard	Total
experience	0-5 years	7	35	17	59
	6-10 years	5	69	28	102
	11-20 years	7	81	52	140
	20+ years	8	36	34	78
Total		27	221	131	379

Table 3.10 shows that by the χ^2 test of association, there is borderline evidence to suggest an association between response and experience ($p=0.06$).

Similarly, the test for trend is also around the 5% level of significance ($p=0.049$).

Table 3.11. Question 4: What is your opinion of the One Leg Stand Test?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
379/380	1	15	198	155	10
99.7%	0.3%	4.0%	52.5%	40.6%	2.6%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 -5 (n = 58)	0	4 (6.9%)	32 (55.2%)	20 (34.5%)	2 (3.4%)
6 -10 (n = 102)	0	3 (2.9%)	59 (57.8%)	38 (37.3%)	2 (2%)
11- 20 (n = 140)	1 (0.7%)	4 (2.9%)	70 (50%)	62 (44.3%)	3 (2.1%)
20 plus (n = 79)	0	4 (5.1%)	37 (46.8%)	35 (44.3%)	3 (3.8%)

Figure 3.9. Question 4. All FME responses.

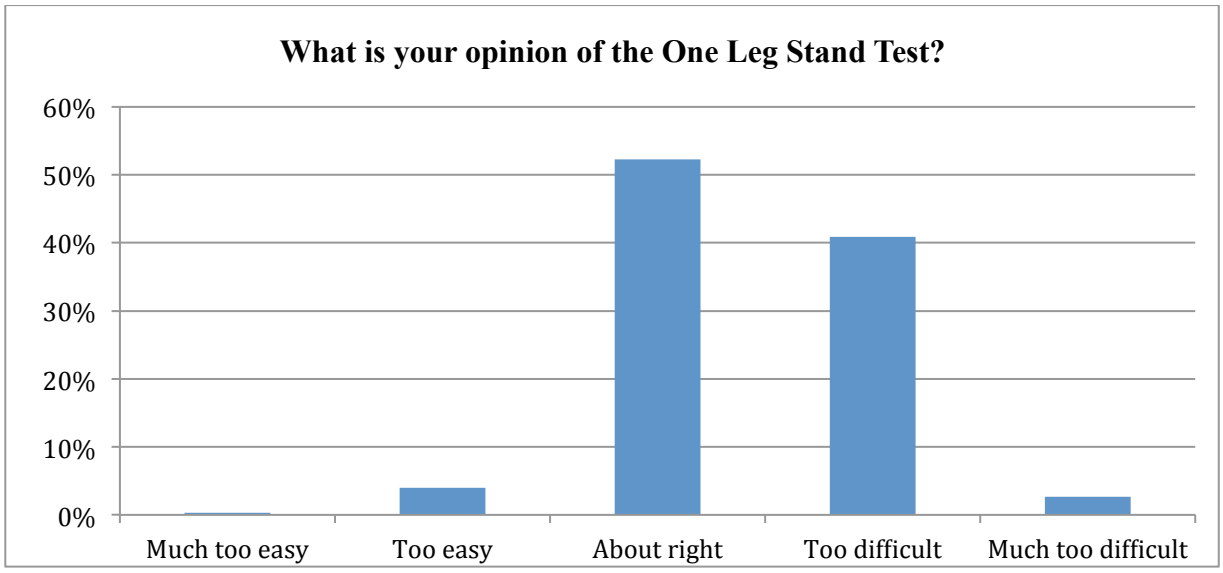
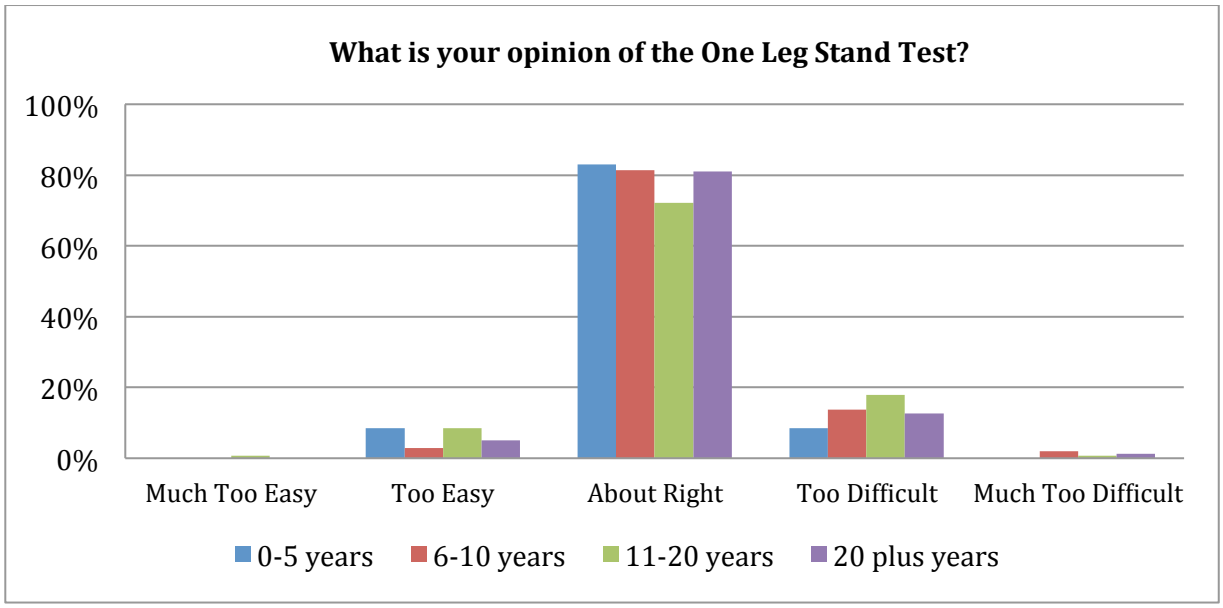


Figure 3.10. Question 4. Responses by years of experience.



Question 4: FME responses - overall.

As with the previous questions the 'about right' category has been disregarded as uninformative and the responses either side have been analysed. It is found again that there is a statistically significant lean towards 'too difficult' (including 'much too difficult') when compared with 'too easy' (including 'much too easy') with the group numbers being 16 versus 165, which is a statistical imbalance on the assumption of equality ($p<0.0001$).

Table 3.12. Question 4: FME responses – by experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		Response			
		too easy	about right	too hard	Total
Experience	0-5 years	4	32	22	58
	6-10 years	4	59	40	103
	11-20 years	5	70	65	140
	20+ years	4	37	38	79
Total		17	198	165	380

Table 3.12 shows there is no evidence to suggest an association between experience and response, either with the χ^2 test of association ($p=0.69$) or χ^2 test for trend ($p=0.13$).

Table 3.13. Question 5: What is your opinion of the Finger Nose Test?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
378/380	3	50	285	38	2
99.5%	0.8%	13.2%	75.4%	10.1%	0.5%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 - 5 (n = 59)	0	12 (20.3%)	43 (72.9%)	4 (6.8%)	0
6 - 10 (n = 102)	0	14 (13.7%)	79 (77.5%)	8 (7.8%)	1 (1%)
11 – 20 (n = 140)	2 (1.4%)	19 (13.6%)	101 (72.1%)	18 (12.9%)	0
20 plus (n = 77)	1 (1.3%)	5 (6.5%)	62 (80.5%)	8 (10.4%)	1 (1.3%)

Figure 3.11. Question 5. All FME responses.

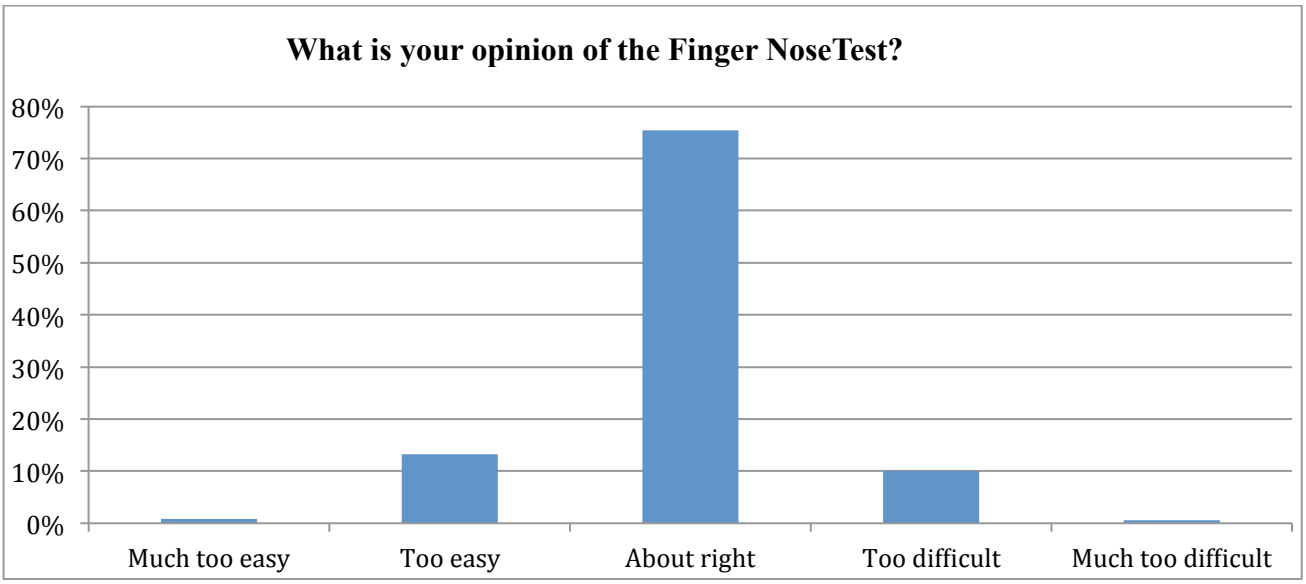
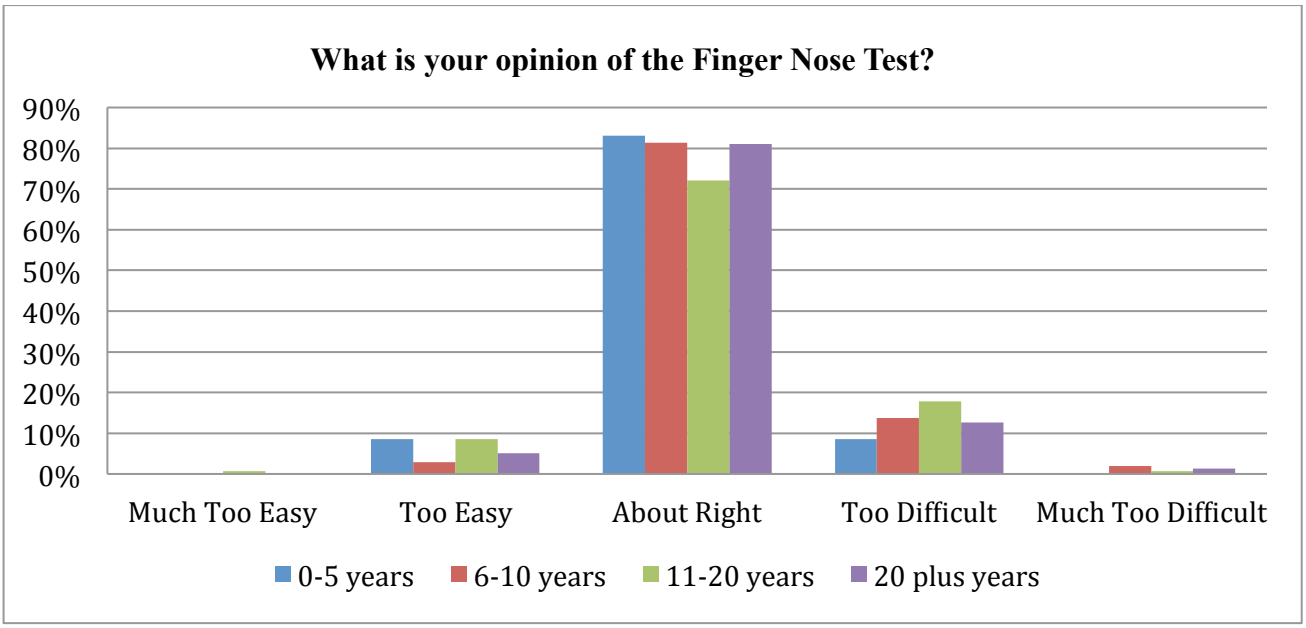


Figure 3.12. Question 5. Responses by years of experience.



Question 5: FME responses - overall.

As with the previous questions the 'about right' category has been disregarded as uninformative and the responses either side have been analysed.

For this test, the balance between 'too easy' and 'too difficult' is not significantly different from equality (53 vs 40, p=0.21).

Table 3.14. Question 5: FME responses – by experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		Response			
		too easy	about right	too hard	Total
Experience	0-5 years	12	43	4	59
	6-10 years	14	79	9	102
	11-20 years	21	101	18	140
	20+ years	6	62	9	77
Total		53	285	40	378

Table 3.14 shows that in this question there is no evidence to suggest an association between experience and response with the χ^2 test of association (p=0.38), although there is some suggestion of a linear trend by the χ^2 test for trend (p=0.04). The distribution of responses tends more towards the 'too hard' option with greater experience.

Table 3.15. Question 6: What is your opinion of the Romberg Test?

No. of respondees	Much Too Easy	Too Easy	About Right	Too Difficult	Much Too Difficult
380/380	1	24	297	54	4
100%	0.3%	6.3%	77.9%	14.5%	1.1%
Yrs Experience	**Much Too Easy**	**Too Easy**	**About Right**	**Too Difficult**	**Much Too Difficult**
0 - 5 (n = 59)	0	5 (8.5%)	49 (83.1%)	5 (8.5%)	0
6 - 0 (n =102)	0	3 (2.9%)	83 (81.4%)	14 (13.7%)	2 (2%)
11- 20 (n = 140)	1 (0.7%)	12 (8.6%)	101 (72.1%)	25 (17.9%)	1 (0.7%)
20 plus (n = 79)	0	4 (5.1%)	64 (81%)	10 (12.7%)	1(1.3%)

Figure 3.13. Question 6. All FME responses.

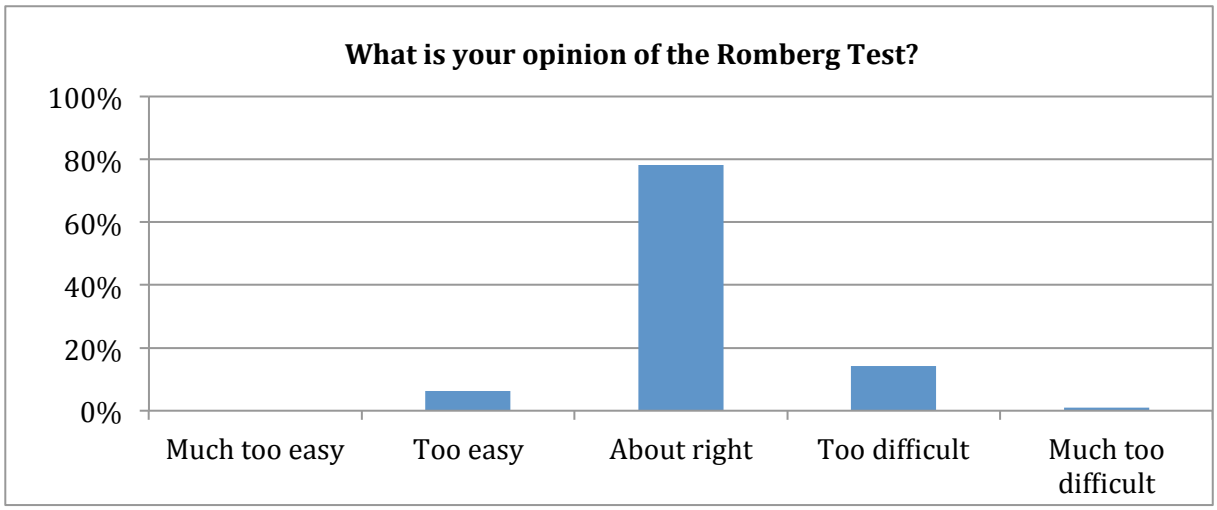
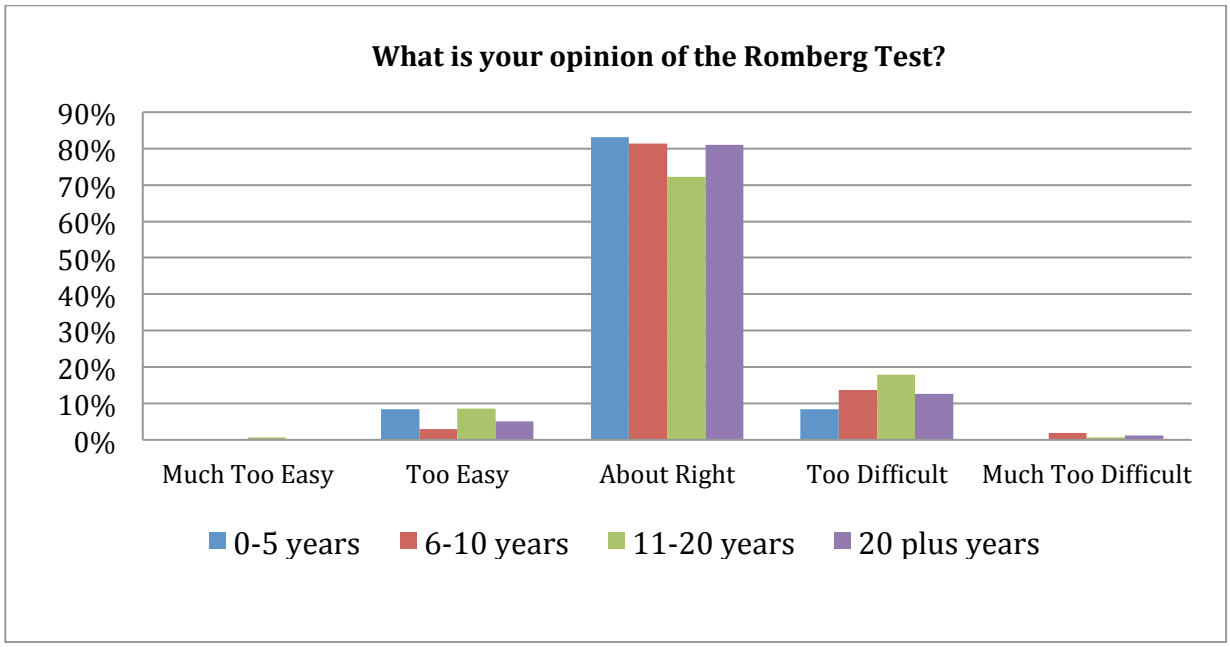


Figure 3.14. Question 6. Responses by years of experience.



Question 6: FME responses - overall.

As with the previous questions the 'about right' category has been disregarded as uninformative and the responses either side have been analysed. It is found that there is a statistically significant lean towards 'too difficult' (including 'much too difficult') when compared with 'too easy' (including 'much too easy') with the group numbers being 25 versus 58, which is a statistical imbalance on the assumption of equality ($p<0.0004$).

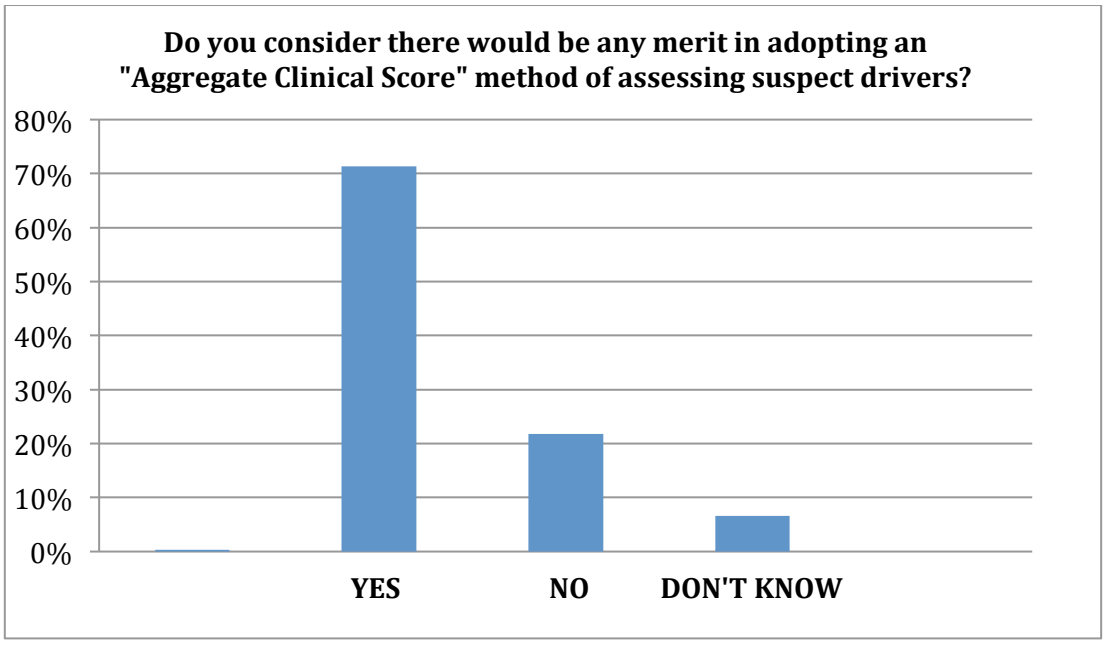
Table 3.16. Question 6: FME responses – by experience.

Collapsing the groups either side of the 'about right' response yields the table below:

		response			
		too easy	about right	too hard	Total
experience	0-5 years	5	49	5	59
	6-10 years	3	83	16	102
	11-20 years	13	101	26	140
	20+ years	4	64	11	79
Total		25	297	58	380

Table 3.16 shows in this question there is no evidence to suggest an association between experience and response, either with the χ^2 test of association ($p=0.23$) or χ^2 test for trend ($p=0.48$).

Figure 3.15. Question 7. All FME response to an "Aggregate Clinical Score"



As indicated in Appendix B question 7 – the FMEs were asked if they considered there to be any merit in adopting a procedure whereby clinical signs which might be considered consistent with clinical impairment due to drugs, are individually scored and aggregated, resulting in a "grand total" or "aggregate clinical score".

The responses are listed diagrammatically above. 272 FMEs approved of an aggregate score; 83 FMEs disapproved; and 25 were uncertain.

With the "don't know" responses excluded, it is highly unlikely that the distribution between YES and NO is equal, given that these numbers (272 vs 83, $p<0.0001$).

If the "don't know" group are included with the no group, it is still unlikely that YES and NO are equal ($p<0.0001$). In conclusion, there are significantly more people saying YES, than saying NO.

Figure 3.16. Question 7." FMEs with postgraduate qualifications and response to "Aggregate Clinical Score" method.

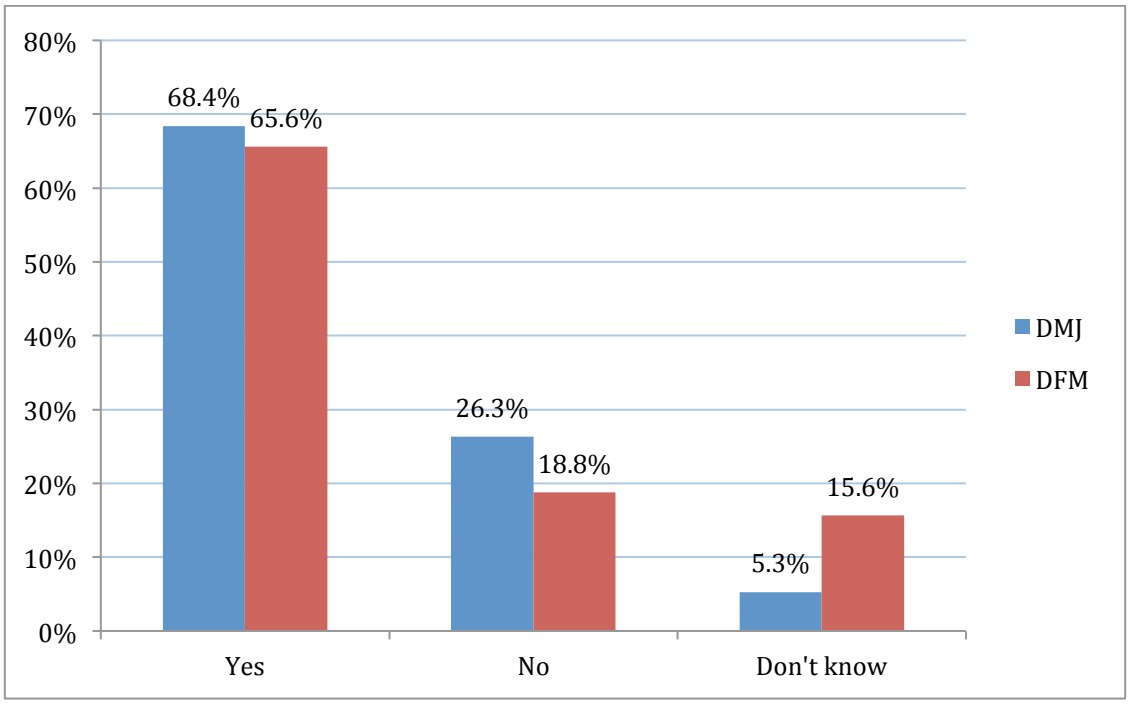


Table 3.17. Question 7: FME responses – by postgraduate experience.

	DMJ	DFM	Total
Yes	52	21	73
No	20	6	26
Don't know	4	5	9
Total	76	32	108

There is no evidence to suggest that the proportions of each response are different for the two qualification groups (p=0.18) using the χ^2 test.

Figure 3.17. FMEs who approved an "Aggregate Clinical Score" by experience.

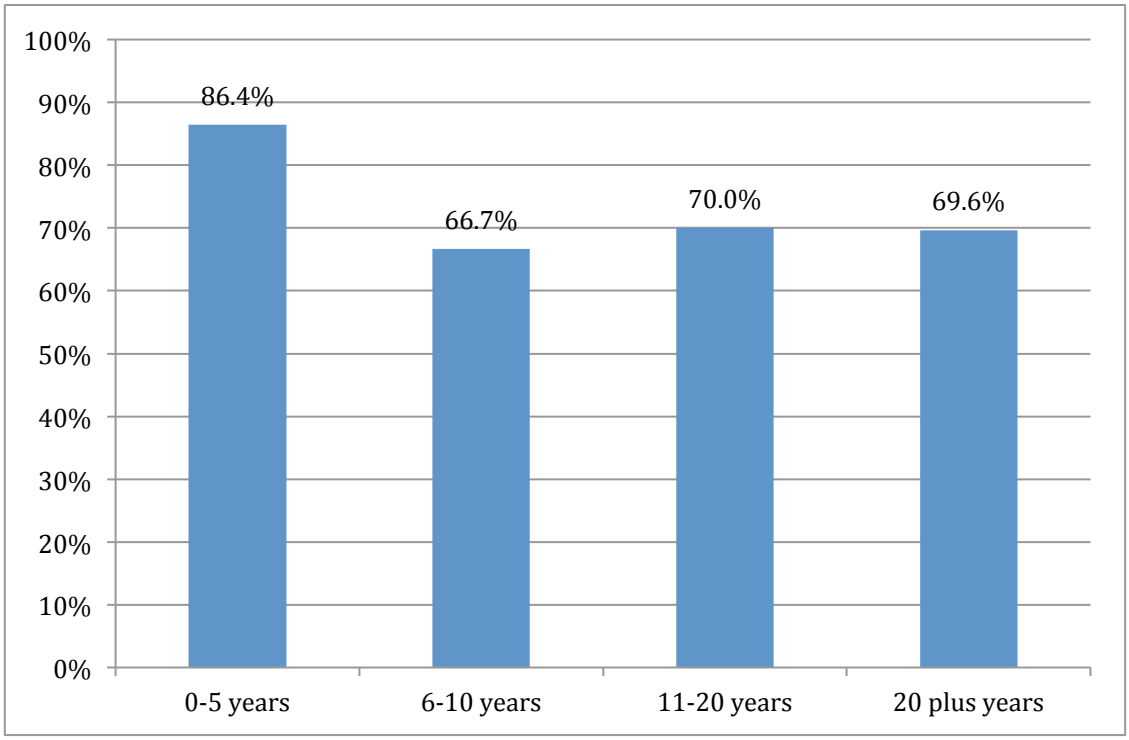


Table 3.18: Question 7: FME responses – by postgraduate experience.

		response		
		Yes	No	Total
experience	0-5 years	51	8	59
	6-10 years	68	34	102
	11-20 years	98	42	140
	20+ years	55	24	79
Total		272	108	380

Table 3.18 shows that in terms of the simple χ^2 test of association, there is some evidence to suggest that there is an association between the level of FME experience in forensic matters and answering 'yes' to the merit of an "aggregate clinical score" (p=0.047). However, this is not a trend (p=0.10).

3.3.3. Comments received from survey respondees.

A notable feature in relation to the comments received from the doctors, was that less than 10% of doctors who considered the tests "about right" provided any written comments on the tests, in contrast to the doctors who considered tests "more difficult" and "much more difficult" where comments were received from 90% and 100% respectively. Only one FME who considered the tests "too easy" provided a suggestion, which was that the One Leg Stand test should be performed blindfolded.

The following are a sample of the comments received and are **exactly as submitted** by the FMEs –

- *"The tests are not relevant to the driving act. Failure to pass the tests does not equate to impairment of driving ability."*
- *"These tests are essentially tests for ataxia with an added cognitive aspect."*
- *"There are naturally clumsy people who cannot pass the tests particularly if anxious."*
- *"Some groups (low IQ) will not be able to understand and follow such complicated instructions. Normal people may also have difficulty, if anxious."*
- *"The tests are too difficult even in non-intoxicated circumstances."*
- *"What we really need is a protocol of tests which assess concentration, co-ordination and reaction time."*
- *"The tests are over-elaborate and over-complicated."*
- *"The tests are about right but the "marking" is much too harsh."*
- *"A 2nd examination for comparison purposes would be of value."*

- *"These tests have no relevance whatsoever to the safe driving of a motor vehicle and will not provide proof of drug-related impairment of driving. Tests more relevant to the tasks associated with safe driving are needed."*
- *"The tests have been validated for alcohol, NOT for drugs."*
- *"These tests are irrelevant and meaningless, not to mention unfair."*
- *"What results does the normal non drugged population have when tested?"*
- *"Courts might find it easier to relate to a score system as suggested."*
- *"Videoing these tests would give the court more idea of impairment."*
- *"Helpful in court to have some kind of scoring measurement system."*
- *"These tests have not been validated for normal values, or for age."*

Perhaps the most reasoned comments regarding the tests were –

- *"I do not believe there is sufficient clinical or scientific correlation between the ability to perform these tests and the ability to drive. There is also not sufficient correlation between the ability to perform the tests and the possible effects or side effects of specific drug use."* (Irvine 2002).
- *"These tests have an academic structure and a non-medical experimental appearance that renders them wholly inappropriate for any field test conducted by a lay (i.e. non-medical trained) individual. They lack any form of sensitivity in application and any interpretive element is missing. In the field, i.e. when applied as planned, they fail to recognise the physiological stress, which exists within the subject, which, if not accounted for, renders them* ***UTTERLY USELESS*** *in clinical terms for any form of evaluation. There is also no adequate means of assessing if other reasons exist medically which would render these tests inappropriate."*. (Boyd 2002).

3.3.4. Survey 3 – Summary and conclusions.

The results of this survey clearly indicate that –

(1) The majority of FMEs (63% n = 234) considered the tests "about right" but a significant group of 33% (n = 123) of FMEs ($p<0.0001$) thought the tests "too difficult, whereas only 4.6% (n = 17) thought the tests "too easy".

(2) The majority of doctors (56%) considered at least one test "too difficult".

(3) Statistical analysis indicates that there is a statistical lean towards "too difficult" when compared to "too easy" in all questions relating to FIT with the exception of question 5 the Finger Nose test.

(4) Tests with the highest approval rate were the Romberg test (77.9%) and the Finger - Nose test (75.4%).

(5) Tests with the lowest approval rate were the One Leg Stand and the Walk and Turn with 43% and 34.8% of FMEs considering them more difficult than appropriate.

(6) The group of doctors with least experience (0 - 5 years) had the highest percentage (72.9%) of doctors who felt the tests "about right".

(7) The group of doctors with greatest experience (20 plus years) had the smallest percentage (53.8%) of doctors who felt the tests "about right".

(8) The percentage of doctors who supported the tests decreased in direct proportion to their level of experience.

(9) An **Aggregate Clinical Score** found favour with the great majority of all doctors with between 66% and 70% throughout all ranges of experience however the least experienced group (0 - 5 years) most strongly supported this suggestion with 86.4% of this group being in favour of such a system.

3.3.5. Survey 3 - Summary of coments received from FMEs.

It was a finding of note that the numbers of doctors who felt the tests to be "about right" decreased as their experience increased (Table 3.7). The question thus arises whether or not the doctors with the greatest experience as FMEs, and who probably had the greatest exposure to examination of suspect drivers and who were likely to be the oldest, had subconsciously allowed their own personal performances (on the tests) to influence their judgements on the suitability of the tests.

Notwithstanding the above, the most common comments made by FMEs, from all experience levels, and irrespective of postgraduate qualifications were –

(1) FIT were too difficult – even for "normal" individuals.

(2) FIT "clues" or "indicators" of impairment were too harsh.

(3) FIT were complex tests of balance, co-ordination and memory but not of impairment in driving ability.

(4) FIT had no relevance to the driving task.

(5) FIT had been validated for alcohol but not for drug use.

(6) FIT involved too many instructions to be easily remembered.

These responses, and in particular the comments received from the FMEs, reinforced my conviction that I had not been wrong in criticising FIT at their initial presentation by Strathclyde Police in June 2000 prior to their introduction under the Railways and Transport Safety Act 2003. The responses and comments received encouraged me to develop the independent study of drug-free individuals in study groups A, B and C detailed in chapter 4.

3.3.6. Discussion of FIT in respect of responses to surveys 1, 2 and 3.

It is accepted that the introduction of a standardised clinical test battery which FMEs can adopt such that all suspect "drug-drivers" are assessed uniformly, professionally and fairly would be both welcome and desirable. The general objectives of the standardised Field Impairment Tests (FIT) should be welcomed in principle however the tests must be clearly seen to achieve their purpose – to test and accurately identify drug related impairment of driving skills in drivers. However several questions must be asked regarding FIT.

1. Can FIT reliably identify or detect evidence of recent drug use in subjects?
2. Can FIT reliably identify or detect impairment in driving ability?
3. Can FIT be accepted as reliable and valid indicators of drug-related impairment in driving ability?

Early studies (Burns and Adler 1995), which suggested these tests accurately indicate impairment due to drugs in a high percentage of cases, remain to be confirmed. Indeed controlled trials when toxicology assays were taken, before and during these tests conducted by Drug Recognition Experts, have clearly shown when cases involving alcohol are excluded, the accuracy level has fallen to 32% - 44% (Wall and Karch 2000).

It must also be noted, in these previously claimed "highly accurate tests" (Burns & Adler 1995; Stuster & Burns 1998) the suspect drivers were all questioned in detail by the Drug Recognition Experts regarding use of drugs, prescribed and illicit, prior

to an opinion being given. This knowledge of recent drug intake might have influenced the DRE, subconsciously or otherwise, in the decision making process.

Notwithstanding the above, when we consider survey 3 it is clear that the majority of comments received from FMEs surveyed were negative in respect of FIT. Certain findings are notable from the returned questionnaires, particularly the high percentage of doctors who considered an **"Aggregate Clinical Score"** to be of value in the overall assessment of suspect "drug-drivers".

Certainly this concept has been successfully implemented in judicial processes relating to Incapacity Benefits within the Social Security (Incapacity for Work) (General) Regulations (1995). In these situations a claimant is examined by a medical practitioner for the presence of evidence of physical conditions which might restrict their ability to perform "routine day to day" functions, for "mental" signs or symptoms which might have a disrupting effect to the extent their daily routine is significantly affected, or indeed for a combination of both. In these circumstances, points are awarded and an aggregate "score" is produced. Should the claimant amass a total of 15 points (physical, or physical + "mental") or a total of 10 points on "mental" parameters alone, they are deemed to be incapacitated to the extent they are unfit for work and thereby entitled to Incapacity Benefits.

Other recognised processes, which successfully apply this concept of aggregate scoring in a medical situation, are –

- The Glasgow Coma Scale – (Jennett and Teasdale 1997)
- The Mini Mental Scale - (Folsten 1975)
- The Revised Trauma Scale – (Champion 1989)

All the above have been validated and their clinical value is beyond doubt. Adoption of an "Aggregate Clinical Score" process might greatly enhance the efficacy of FIT.

Tasks more directly related to the act of driving were suggested by some doctors, irrespective of their opinion on the current format of FIT. Several FMEs considered FIT were essentially tests for ataxia with an added cognitive element, however were by no means specific indicators of the ability to adequately and safely perform the driving task.

Finally, several respondees suggested that a "**2nd examination"** several hours later, of a driver who had shown evidence of impairment thought to be due to the effects of a drug or drugs, would be useful for purposes of comparison. Any significant change in performance, particularly an improvement, might be considered corroborative evidence of the doctor's opinion that the previously recorded evidence of "impairment" was due to the effects of some drug(s) whose effect had by then "worn off". This suggestion would however carry financial implications for the police who would keep the driver in detention, but would also have implications in respect of the liberty of the individual concerned. While this proposal would be likley to clarify the question of drug-impaired driving in the individual concerned, both police and civil liberty groups might question the responsibility and right to detain the suspect.

However in Scotland such a situation currently exists and has been thoroughly detailed (Wheatley 2000). This procedure was used for many years as a matter of routine by FMEs in Strathclyde Police when dealing with "drunk drivers" and the invariable improvement in performance in the 2nd examination was led by police as strong evidence that the poor performance in the initial tests had been due to alcohol intoxication, and that this intoxication had "worn off" naturally by the time of the second examination.

In conclusion, evidence from the surveys undertaken clearly indicates that a significant number of FMEs in the U.K. who are experienced in dealing with suspect "drug-drivers" have expressed concern regarding the suitability of FIT as reliable indicators of drug-related impairment of driving ability.

3.3.7. Limitations of Survey 3.

A great number of comments (100 plus) were received from FMEs who disapproved of FIT, however very few (less than 20) from FMEs who approved of FIT. It may be considered that those FMEs who provided comments were particularly strident in their opinion, however there is no evidence to suggest that this was the case.

It may be considered that there is no direct correllation between length of years experience as an FME and the amount of experience examining suspect drug-drivers using FIT procedures, and this is acknowledged. Indeed this was one of the factors which was a stimulus for me, as a very experienced FME using FIT procedures to undertake the further resaerch studies detailed in chapter 4.

CHAPTER 4. Evaluation of drug-free detainees – How do they perform FIT?

The validity of FIT has been questioned (Erwin 1995; Trocino 1997; Head 2001; Hartley 2001; Boyd 2002; Irvine 2002; Johnston and Ramsey 2003; Rubenzer 2008; FFLM in North 2010d; Stark 2010; Verstraete and Legrande 2010) and the ability of the tests to withstand challenge in court is a legitimate question which as yet, remains to be answered. Indeed the question of how drug-free individuals perform FIT is crucial when assessing their relevance as indicators of impairment of driving ability due to the effects of recent drug use.

For this reason I have specifically chosen to apply FIT and also conventional tests of psychomotor function to three separate core groups who were known to have taken no drugs for a period of at least 8 hours prior to undertaking the Field Impairment Tests since they had been detained in police custody for at least 8 hours prior to my examination (data are available in Appendices F; G and H).

Group A were detainees who claimed to be addicted to heroin and who claimed suffering from "withdrawals".

Group B were detainees who had formerly been addicted to heroin but were now stabilised on legally prescribed methadone as substitution therapy.

Group C were detainees who clearly denied any current or past use of drugs.

Group A: The majority of these subjects presented as unwell, showing evidence of physical and psychological distress, and exhibiting signs of multiple complaints including - sweating, tremors, muscle cramps and spasms, abdominal pains, diarrhoea, restlessness, anxiety, irritability, and agitation. Under test conditions, these clinical states had the potential to be both physically and mentally disabling, and to varying degrees, adversely affect the subjects' ability to perform the tests.

Group B: The majority of subjects presented as entirely well with no physical complaints or abnormal clinical signs. Although they had requested administration of their legally prescribed medication (methadone) upon which they were dependent, they showed no evidence at all, of either physical or mental distress, and this was entirely consistent with the 24 hour action of methadone. It was clinically evident that these individuals were physically and psychologically comfortable and were not at all hindered by their medical condition in performing the tests.

Group C: The majority of subjects presented as well, with no abnormal physical or pscyhological problems which might have hindered them in performing the tests.

4.1. Questions to be addressed in respect of FIT.

The questions I wish to address in relation to study groups A; B; and C are –

1. How well or how poorly do these drug-free individuals perform FIT?
2. Which test(s), if any, cause difficulty in these drug free subjects?
3. Can FIT be regarded as a reliable indicator of recent drug use and effects?

4.1.1. Study Group A: Detainees "in withdrawal" - Methods.

Study Group A comprised 100 male detainees who had been in custody for at least 8 hours and had requested medical attention due to their claimed addiction to heroin and who claimed to be suffering "withdrawal" effects. All subjects were examined within the confines of the medical examination suites of Strathclyde Police "Q" Division Lanarkshire following their request to be seen and treated by a doctor. Group A subjects aged from 18 years to 38 years with a median age of 27 years.

Any detainee showing clinical evidence of any of the following was excluded -

- Acute intoxication due to alcohol
- Acute intoxication due to drugs
- Acute physical injury
- Chronic locomotor disability
- Neurological condition
- Acute psychiatric disorder
- Acute medical problems
- Significant chronic health problems

A detailed medical history (appendix E) was taken in order to ensure the absence of any exclusion criteria. The subjects were then examined for evidence of recent injury and any significant deformities or abnormalities. Their general appearance and demeanour was noted, and conscious level and mental state were assessed. Clinical examination included an assessment of the speech in both manner and content. A cardiovascular assessment was performed with pulse, blood pressure and heart rate recorded and the skin examined for temperature and sweating. The eyes were examined with specific reference to pupil size and reaction to light; hyperaemia; nystagmus; and lack of convergence. Reflexes and reaction time were tested.

Each of the subjects was assessed by three separate methods –

1) In strict accord with FIT procedures and using “clues” or “indicators”.
2) Using FIT but without reference to “clues” or “indicators”.
3) Using conventional psychomotor tests.

The conventional psychomotor tests included an assessment of reflexes and simple reaction time, with traditional straightforward tests of balance and co-ordination including standing with eyes closed, standing on one leg, walking in a straight line, and picking up small objects and placing them carefully in a specific manner as instructed. In addition a simple memory test was conducted with the subject simply asked to remember my name and repeat it when asked, at the end of the examination.

The subjects were assessed and scored in respect of their performance on each test parameter – FIT; FIT minus “clues”; and conventional psychomotor tests. Initially the performance of each individual subject was studied on each of the four individual tests in FIT (Walk & Turn; One Leg Stand; Finger Nose; Romberg) on a “pass/fail” basis applying strict FIT criteria (appendix A). The same performance for that individual was then assessed using FIT minus “clues”, again on a “pass/fail” basis. Finally the performance of the same subject was assessed using conventional assessments of psychomotor function, which had been part of the general clinical examination. This process yielded the preliminary results, which can be used for comparison with those of subjects in groups B and C (Tables 4.1 and 4.4).

Subjects who completed the tests satisfactorily according to the test criteria were scored one point whereas subjects who could not complete the tests satisfactorily

were scored zero. The scores were amalgamated for each group and all counts were scored out of 100. This allowed for more detailed analysis of the performance on individual tests and enabled more accurate interpretation of the findings.

4.1.2. Study Group A - Results and preliminary analysis

Table 4.1. Percentage of Group A subjects able to perform different tests.

	FIT	FIT minus "clues"	Conventional Tests
Walk & Turn	27	41	88
One Leg Stand	18	28	93
Finger Nose	21	94	99
Romberg	82	96	99

Table 4.1. shows that :-

In general, group A subjects performed very poorly in FIT, and FIT minus "clues", with the exception of the Romberg and Finger Nose tests.

All subjects performed each test better when assessed without observation of "clues" or "indicators" of impairment, and better again when assessed using conventional psychomotor trests of balance and co-ordination.

Using strict FIT criteria the One Leg Stand test and Walk and Turn caused the most obvious difficulty due to poor balance and co-ordination.

Using strict FIT criteria, it was notable that the subjects had difficulty maintaining balance when standing prior to beginning the test, and also standing on one leg with foot raised and parallel to the floor, but only when required to look at the raised foot.

Using strict FIT criteria the subjects appeared to be unable to fully remember the instructions in order to successfully complete the Walk and Turn, Finger-Nose, and One Leg stand tests.

Using strict FIT criteria the subjects who did not successfully complete the finger-nose test had used the pad of the finger despite being told and reminded to use the tip. However this might not accurately reflect their ability to perform the test.

It was notable that many subjects presented as anxious, restless and agitated and exhibited a lack of patience throughout all of the examination processes.

All subjects who failed to successfully perform the Romberg test estimated the 30 second time interval in less than 20 seconds and this was consistent with their general impatience throughout the examination process.

Although many of the subjects in group A presented as impatient, only those who presented as particularly restless and agitated failed to perform the Romberg test satisfactorily.

4.2.1. Study Group B (methadone dependent detainees).

Study Group B comprised 100 male detainees who had been in custody for at least 8 hours and had requested administration of their legally prescribed methadone whilst in custody. The age range in Group B subjects was from 25 years to 46 years with a median age of 31 years.

4.2.2. Study Group B – Results and preliminary analysis.

Table 4.2. Percentage of Group B subjects able to perform different tests.

	FIT	FIT minus "clues"	Conventional Tests
Walk & Turn	63	88	98
One Leg Stand	56	83	98
Finger Nose	88	100	100
Romberg	92	100	100

Table 4.2. shows that :-

Group B subjects performed significantly better than group A subjects in all tests with the exception of the Romberg test, in which they performed only slightly better.

As before, all subjects performed each test better when assessed without observation of "clues" or "indicators" of impairment, and better again when assessed using conventional psychomotor trests of balance and co-ordination.

Using strict FIT criteria, a notable number of subjects were unable to maintain balance when standing either with one foot in front of the other, or standing on either leg with foot raised and parallel to the floor, however this was much less than noted in group A subjects.

Although a small number of subjects appeared to be impatient during the examination process, none displayed any significant degree of anxiety or agitation.

Using strict FIT criteria during the Finger-Nose test the only subjects who failed to successfully complete the test had used the pad of the finger despite being told and reminded to use the tip.

As before, the subjects who failed to successfully perform the Romberg test had estimated the 30 second time interval in less than 20 seconds and this was consistent with their general impatience throughout the examination process.

As previously noted in Group A subjects, the tests which presented most difficulty to the subject group were the One Leg Stand test and the Walk and Turn test.

4.3.1. Study Group C – Drug-free "control" detainees.

Study Group C comprised 100 male detainees who had been in custody for at least 8 hours and had denied any illicit drug abuse. The same strict exclusion criteria were applied as in Group A. years. This group was included as a "control" group as they had no history of previous drug use. The age range was from 19 years to 49 years with a median age of 32 years.

4.3.2. Study Group C - Results and preliminary analysis.

Table 4.3. Percentage of Group C subjects able to perform different tests.

	FIT	FIT minus "clues"	Conventional Tests
Walk & Turn	78	92	98
One Leg Stand	81	91	97
Finger Nose	91	100	100
Romberg	96	100	100

Table 4.3. shows that :-

Group C subjects performed FIT, both with and without "clues" or indicators" better than groups A and B with the exception of the Finger Nose and Romberg tests.

All subjects performed the tests better when assessed without observation of "clues", and better again when assessed using conventional psychomotor trests, with the exception of the Finger Nose and Romberg tests.

Using strict FIT criteria, it was notable that in this group of "normal" detainees, who gave no history of medicinal or illicit drug use, only 78% managed to successfully complete the Walk and Turn test; and 81% the One Leg Stand Test.

Using FIT, both with and without "clues" or "indicators", the subjects who were unable to successfully complete the Walk and Turn test had a degree of difficulty maintaining balance when standing with one foot in front of the other, or completing the turn in the apropriate manner.

Using FIT, both with and without "clues" or "indicators", the subjects who were unable to successfully complete the One Leg Stand test had a degree of difficulty maintaining balance without raising their arms or swaying slightly.

All subjects who were unable to successfully perform the finger-nose test did touch the tip of their nose with the correct finger however used the pad of the finger despite being able to touch the tip of their nose with the tip of their finger.

Subjects who failed to complete the Romberg test successfully had good balance with closed eyes however did not estimate 30 seconds within the required range.

4.4. Comparison of results from Groups A, B and C.

There is an evident disparity in the performance of the three groups (Table 4.4) with group A performing particularly poorly in both FIT and FIT minus "clues", when compared to groups B and C. However there is less disparity between the groups in respect of their performance in conventional psychomotor tests. The performance of groups B and C was similar in the four individual tests, in respect of FIT minus

"clues" and conventional tests. However when using strict FIT criteria group B performed less well in the One Leg Stand and Walk & Turn tests than group C.

It was noted when using strict FIT criteria a large number of subjects from groups A and B were unable to complete the tests satisfactorily, however a number of subjects from group C were also unable to perform the Walk & Turn and One Leg Stand tests.

In conclusion, it is evident that a number of subjects from each group were unable to perform FIT despite being known to be drug free at the time of testing.

Table 4.4. Percentage of subjects who successfully completed individual tests.

Walk & Turn	**Group A**	**Group B**	**Group C**
FIT	27	63	78
FIT minus "clues"	41	88	92
Conventional tests	88	98	98

One Leg Stand	**Group A**	**Group B**	**Group C**
FIT	18	56	81
FIT minus "clues"	28	83	91
Conventional tests	93	98	97

Finger-Nose	**Group A**	**Group B**	**Group C**
FIT	21	88	91
FIT minus "clues"	94	100	100
Conventional tests	99	100	100

Romberg	**Group A**	**Group B**	**Group C**
FIT	82	92	96
FIT minus clues	96	100	100
Conventional tests	99	100	100

Table 4.4. clearly shows that the drug dependent detainees in Group A and B, who were known to have taken no drugs in the previous 8 hours and who showed no clinical evidence of intoxication due to any CNS active drug, performed more poorly in all tests, and even more so in FIT, than the "normal" or "control" detainees in Group C. It is also evident that while virtually all subjects in Group C managed to complete the conventional tests successfully, a number of these "normal" individuals were unable to complete FIT successfully, with the Walk and Turn test (n = 22), and One Leg Stand test (n = 19) in particular.

Statistical analysis was undertaken and the results of each test in each group were compared, with one point awarded for successful completion of a test. All counts are out of 100. Values in the cells indicate the number of passes in each group/test. Logistic regression is a form of general linear model with a binary outcome 'y' variable. In these analyses, allowance has been made for the correlation between the tests, due to each test being done by the same set of individuals. For simplicity, a χ^2 test has also been used to compare groups A and C. Where numbers are small (very close to zero or very close to 100), a Fisher's Exact Test has been applied.

The Walk and Turn Test.

Analysing the results of the Walk & Turn test by logistic regression (Table 4.4) shows there are significant differences between the tests and the groups (both $p<0.0001$). Also, taking the "normal" group, C, as the comparator group, both group A ($p<0.0001$) and group B ($p=0.023$) are significantly different from C (overall, having taken the test into consideration already). As group B should be similar to group C, this clearly indicates that this is not the case.

The p-values here have been adjusted for multiple comparisons using Tukey's method. Both FIT and FIT minus clues are significantly different from the conventional test (both $p<0.0001$).

In simpler terms, looking at group A vs. group C for each test individually with the χ^2 test, we have:

FIT: $p<0.0001$, group A's scores are significantly different from group C's scores.

FIT minus clues: $p<0.0001$, group A's scores are significantly different from group C's scores.

Conventional: $p=0.006$, group A's scores are significantly different from group C's scores, although by a lower margin.

The One Leg Stand Test.

Analysing the results of the One Leg Stand test by logistic regression (Table 4.5.) shows there are significant differences between the tests and the groups (both $p<0.0001$).

Again, as with the Walk & Turn test, A is significantly different from C ($p<0.0001$) and B is significantly different from C ($p=0.002$). As group B should be similar to group C, this clearly indicates that this is not the case.

Both FIT and FIT minus clues are significantly different from the conventional test (both $p<0.0001$).

Looking at A vs. C, we have:

FIT: $p<0.0001$, group A's scores are significantly different from group C's scores.

FIT minus clues: $p<0.0001$, group A's scores are significantly different from group C's scores.

Conventional: $p=0.19$, group A's scores are not significantly different from group C's scores. The conventional test is unable to distinguish between group A and group C on this test.

The Finger-Nose Test.

Analysing the Finger-Nose test by logistic regression (Table 4.5.) shows there are significant difference between the tests and the groups (both $p<0.0001$).

However, in this case, only group A is significantly different from group C ($p<0.0001$), group B is not significantly different from C ($p=0.37$).

Both FIT and FIT minus clues are significantly different from the conventional test ($p<0.0001$ and $p=0.027$, respectively).

Looking at A vs. C, we have:

FIT: $p<0.0001$, group A's scores are significantly different from group C's scores.

FIT minus clues: $p=0.03$, group A's scores are significantly different from group C's scores*.

Conventional: $p=0.99$, there is no difference between group A and group C*.

The Romberg Test.

Analysing the results of the Romberg test by logistic regression (Table 4.5.) shows there are significant differences between the tests and the groups (both $p<0.0001$). However, again only group A is significantly different from group C ($p<0.0001$), group B is not significantly different from group C ($p=0.16$).

Additionally, the FIT test is significantly different from the conventional test ($p<0.0001$), but the FIT minus clues test is not significantly different from the conventional test ($p=0.13$).

Looking at A vs. C, we have:

FIT: $p=0.002$, group A's scores are significantly different from group C's scores.

FIT minus clues: $p=0.12$, group A's scores are not significantly different from group C's scores*.

Conventional: $p=0.99$, group A's scores are not significantly different from group C's scores*.

* These tests were performed using the Fisher's Exact Test, due to small expected numbers in some cells, which could invalidate the χ^2 test.

4.4.1. Summative results of all tests in Groups A, B, and C.

An alternative use of the data would be to count the number of tests that the subject successfully performed, to test the opposing hypotheses -

1. **FIT are reliable and valid tests of drug-related impairment to drive - all groups should pass all tests and score equally since all are drug-free.**

2. **FIT are not reliable and valid tests of drug-related impairment to drive - and are too difficult for some groups of drug-free individuals to perform.**

Summative scores for each group may be calculated as follows –

FIT = Walk & Turn score + One Leg Stand score + Finger-Nose score + Romberg score, where a yes answer counts as 1 point. The range of FIT (or FIT minus "clues" or conventional tests) can vary from 0 to 4.

Table 4.5. FIT scores for groups A, B, and C

		Group			Total
		A	B	C	
FIT	.00	18 (64.3%)	8 (28.6%)	2 (7.1%)	28
	1.00	52	4	7	63
	2.00	6	25	10	41
	3.00	12	7	5	24
	4.00	12 (8.3%)	56 (38.9%)	76 (52.8%)	144
Total		100	100	100	300

Table 4.5 shows that although it is less likely that a score of zero came from a person in group C, it is not possible to completely discount the possibility, as 7.1% (2/28) of scores of 0 appear in group C. Similarly, it is possible, although unlikely, that a score of 4 came from a person in group A (8.3%, 12/144). It would be even more difficult to categorise patients into group B.

Table 4.6. FIT minus "clues" scores for groups A, B, and C

		Group			Total
		A	B	C	
FIT minus "clues"	.00	4 (100%)	0 (0%)	0 (0%)	4
	1.00	2	0	0	2
	2.00	53	12	8	73
	3.00	13	5	1	19
	4.00	28 (13.9%)	83 (41.1%)	91 (45.0%)	202
Total		100	100	100	300

Table 4.6 shows that although this looks more promising, with all scores of 0 coming from patients in group A, the probability of this distribution of the data is 1 in 15 (p=0.067) by random chance. Scores of 1 are also only recorded in group A. Also, it is still not possible to assign or exclude a score of 4 to any particular group with any degree of certainty, as 13.9% of scores of 4 come from group A.

Table 4.7. Conventional test scores for groups A, B, and C.

		Group			Total
		A	B	C	
Conventional Tests	.00	1 (100%)	0 (0%)	0 (0%)	1
	2.00	6	2	2	10
	3.00	5	0	1	6
	4.00	88 (31.1%)	98 (34.6%)	97 (34.3%)	283
Total		100	100	100	300

Table 4.7 shows that very few subjects scored less than 4 in the conventional tests (5.7%). Although the single score below 2 came from group A, this is insufficient evidence to accept as a valid test. Even amalgamating scores of 0-3, 70.6% (12/17) come from group A, with 11.8% (2/17) and 17.6% (3/17) from B and C respectively. Similarly, for scores of 4, there is a roughly equal distribution across the groups (goodness of fit test, p=0.22, no significant difference between the groups).

4.4.2. Confounding subjects in Group A - re-analysis.

Following my examination of Group A subjects it was evident to me that certain individuals (n =12) had shown no evidence whatsoever of the normal clinical signs of opiate withdrawals, specifically no cold or sweaty skin with "gooseflesh" which is a common indicator of opiate withdrawal syndrome, however most importantly no evidence of grossly dilated pupils which is virtually pathognomonic. These 12 individuals were given no drug replacement therapy since I detected no clinical evidence which supported their assertions of drug withdrawals and thus no therapeutic indication to provide drug replacement therapy. Indeed I was not entirely convinced they were habitual drug abusers to any considerable extent.

It is my opinion that these 12 individuals were "confounders" since I am confident, based on my experience of 30 years experience of dealing with detainees and in particular "drug-dependent" detainees, that they were simply claiming to be "in withdrawal" and making misleading claims regarding their condition in an attempt to receive drugs simply to make their period of detention less uncomfortable. These 12 individuals had thus distorted the results of group A and it was felt appropppriate to re-analyse the results of Group A with these subjects excluded (Table 4.8).

Further analysis of Group A was undertaken with the 12 "confounders" excluded. Subsequent subject numbers were reduced (n=88), with primary results in brackets.

Table 4.8. Percentage of Group A subjects able to perform different tests.

Test	FIT	FIT minus "clues"	Conventional Tests
Walk & Turn	17 (27) *	33 (41) *	86.4 (88)
One Leg Stand	6.8 (18) *	18.2 (28) *	92 (93)
Finger Nose	10.2 (21)*	93.2 (94)	99 (98.9)
Romberg	79.5 (82)	95.5 (96)	98.9 (99)

* indicates a significant difference between excluded and non-excluded patients.

Table 4.8 shows very little difference is noted in the conventional tests. However, significant differences are noted in some FIT and FIT minus "clues" categories.

In the Walk & Turn/FIT test, all 12 excluded subjects successfully performed the test, compared with 17% of the non-excluded subjects. This is a statistically significant difference with the χ^2 test ($p<0.0001$).

In Walk & Turn/FIT minus clues, again, all 12 excluded patients were successful, compared with 33% of the non-excluded. Statistically significant result, $p<0.0001$.

One Leg/FIT, all 12 excluded patients performed successfully, compared with only 6.8%, $p<0.0001$.

One Leg/FIT minus clues, all 12 excluded patients performed successfully, compared with only 18.2%, $p<0.0001$.

Finger-Nose/FIT, all 12 excluded patients performed successfully, compared with only 10.2%, $p<0.0001$.

Finger-Nose/FIT minus clues, all 12 excluded patients performed successfully, compared with 93.2%, not significantly different, $p=0.35$.

Romberg/FIT, all 12 excluded patients performed successfully, compared with 79.5%, not significantly different, $p=0.08$.

Romberg/FIT minus clues, all 12 excluded patients performed successfully, compared with 95.5%, not significantly different, $p=0.45$.

Table 4.9. Percentage of subjects who successfully completed the Walk & Turn test.

Walk & Turn	**Group A**	**Group B**	**Group C**
FIT	15/88 (17%)	63	78
FIT minus "clues"	29/88 (33%)	88	92
Conventional tests	76/88 (86.4%)	98	98

Table 4.9 shows that using the logistic regression techniques, there is very little change to the overall results. Differences have become more marked (i.e. more significant), but as they were already $p<0.0001$, it makes no difference to the conclusions. The comparison of B with C has changed marginally ($p=0.027$), likely due to the influence of the overall variability due to the reduced numbers in group A.

By the χ^2 test, looking at A compared with C, the conclusions for FIT and FIT minus clues are unchanged. Looking at the conventional test, p is now 0.002, so more significant, although no change to the conclusion that they are different.

Table 4.10. Percentage of subjects who successfully completed One Leg Stand test.

One Leg Stand	**Group A**	**Group B**	**Group C**
FIT	6/88 (6.8%)	56	81
FIT minus "clues"	16/88 (18.2%)	83	91
Conventional tests	81/88 (92%)	98	97

Table 4.10 shows the differences between the groups and tests are still highly significant ($p<0.0001$). A is still highly significantly different from C ($p<0.0001$), although it is slightly less significant. Similarly, B is still significantly different from C, but at a lower level ($p=0.007$). FIT and FIT minus clues remain significantly different from conventional, but again, marginally less so.

By the χ^2 test, looking at A compared with C, FIT and FIT minus clues remain statistically significant ($p<0.0001$). Looking at the conventional test, p is now 0.13, so no change to the conclusion that they are unlikely to be different.

Table 4.11. Percentage of subjects who successfully completed the Finger-Nose test.

Finger-Nose	Group A	Group B	Group C
FIT	9/88 (10.2%)	88	91
FIT minus "clues"	82/88 (93.2%)	100	100
Conventional tests	87/88 (98.9%)	100	100

Table 4.11 shows that group and test remain highly significantly different. A is still highly significantly difference from C ($p<0.0001$), and B remains non significant ($p=0.35$). FIT is still highly significantly different from conventional ($p<0.0001$), and FIT minus clues has become slightly more significantly different with $p=0.023$.

By the χ^2 test, A vs C, FIT remains highly significant ($p<0.0001$). FIT minus clues has become marginally more significant ($p=0.01$*), and conventional remains non-significant ($p=0.47$*).

As before, tests performed with the Fisher's Exact Test have been indicated with *.

Table 4.12. Percentage of subjects who successfully completed the Romberg test.

Romberg	Group A	Group B	Group C
FIT	70/88 (79.5%)	92	96
FIT minus clues	84/88 (95.5%)	100	100
Conventional tests	87/88 (98.9%)	100	100

Table 4.12 shows that group and test are still highly significantly different ($p<0.0001$). A is still highly significantly difference from C ($p<0.0001$), and B remains non significant ($p=0.15$). FIT is still highly significantly different from conventional ($p<0.0001$), and FIT minus clues remains non-significant ($p=0.12$).

By the χ^2 test, A vs C, FIT has become more highly significant ($p<0.0005$). FIT minus clues has become significant ($p=0.046$*), and conventional remains non-significant ($p=0.47$*).

Summary

There has been very little change in terms of the conclusions drawn from the results. Only one result has changed from non-significant to significant (Romberg FIT minus clues) and that is only marginal, none have changed in the other direction.

4.4.3. Summative results of tests – Groups A (minus "confounders"), B, and C.

Table 4.13. FIT scores for groups A, B, and C

		Group			
		A	B	C	Total
FIT	.00	18 (64.3%)	8 (28.6%)	2 (7.1%)	28
	1.00	52	4	7	63
	2.00	6	25	10	41
	3.00	12	7	5	24
	4.00	0 (0%)	56 (42.4%)	76 (55.6%)	132
Total		88	100	100	288

Table 4.13 shows with removal of the 12 suspect subjects, none of group A now manage all 4 tasks. However, it is still not possible to discount subjects with a score of 0 from group C.

Table 4.14. FIT minus "clues" scores for groups A, B, and C

		Group			
		A	B	C	Total
FIT minus clues	.00	4 (100%)	0 (0%)	0 (0%)	4
	1.00	2	0	0	2
	2.00	53	12	8	73
	3.00	13	5	1	19
	4.00	16 (8.4%)	83 (43.7%)	91 (47.9%)	190
Total		88	100	100	288

Table 4.14 shows although lower, the percentage of subjects scoring 4 in group A is still too high to use it as a method of discrimination.

Table 4.15. Conventional test scores for groups A, B, and C

		Group			
		A	B	C	Total
Conventional	.00	1 (100%)	0 (0%)	0 (0%)	1
	1.00	0	0	0	0
	2.00	6	2	2	10
	3.00	5	0	1	6
	4.00	76 (28.0%)	98 (36.2%)	97 (35.8%)	271
Total		88	100	100	288

Table 4.15 shows the majority of subjects are still scoring 4 in this test (94.1%), thus a good score is not at all discriminatory. There is still no significant difference between the groups in terms of the distribution across scores of 4, p=0.18.

4.5. Limitations of the studies.

There may be some concern that all subjects in the study groups were male, however male drivers within the age group of those subjects studied (18 to 49 years) are exactly representative of the drivers stopped by police as suspect drug-drivers. I would add that in my 30 years of experience as an FME dealing with several hundreds of suspect drug-drivers I have, on only one occasion, examined a female suspect drug-driver.

There might also be some concern that not all individuals in the study groups who had been in custody for at least 8 hours, were drug-free since diazepam has a half-life of approximately 30 hours and methadone a half-life of 15 to 72 hours with a mean of around 22 hours (Drummer 2001; NHTSA 2004), thus some subjects might still have been under the sedative influence of benzodiazepines or methadone at the time of the examination. However due to the strict exclusion criteria applied (4.1.1.) it is very unlikely that I would have been unable to detect the clinical signs of acute drug intoxication, and those of benzodiazepines or methadone in particular.

In addition there might be some concern whether or not the groups studied were in fact truly representative of car drivers and it is acknowledged that none of the subjects were asked if they held a current driving licence or had passed a driving test. However it is also acknwoledged that some drivers stopped by police and subjected to FIT have no valid driving licence. In any event the purpose of the research was to ascertain how well or how poorly “drug free” individuals performed FIT.

4.6. Summary and conclusions.

Preliminary Field Impairment Tests (FIT) are presented as, and claimed to be, reliable tests of drug-related impairment of driving ability (Sexton et al. 2000; Sexton et al. 2002; Railways and Transport Safety Act 2003; North 2010) and as such it is reasonable and logical to expect drug-free individuals will be able to successfully perform these tests without any significant difficulty. However the results of the research studies undertaken clearly demonstrate this is not the case.

Following analysis of the studies, certain findings were notable.

Although all the subjects in the three groups were known to have taken no drugs for at least 8 hours prior to testing, and may reasonably described as free from the acute effects of drugs, all subjects did not perform equally well on the tests.

All subject groups performed best on the conventional psychomotor and cognitive tests, least well on FIT, and better on FIT minus "clues".

Group A subjects clearly performed less well on all tests than individuals from groups B and C.

Group C subjects who claimed no involvement with drugs, performed better than groups A and B, however not all group C subjects could successfully perform FIT, although virtually all (97-100%) could successfully perform conventional psychomotor tests of balance co-ordination and cognitive function (Table 4.4).

Throughout all the groups, the One Leg Stand and Walk and Turn tests proved most difficult to perform (Table 4.4).

The results of all test groups, most notably group A, less so group B, however also notably group C, support the assertions held by significant numbers of FMEs ($p<0.0001$) that FIT are too difficult, with the One Leg Stand (43% of FMEs Table 3.11) and Walk and Turn (35% of FMEs Table 3.9) tests in particular.

All subject groups performed well in conventional psychomotor tests with groups B and C scoring 98-100% success rates. Group A had a lower, though still high success rate of 88-99% (Table 4.4).

All groups showed a greater degree of consistency in performing the conventional psychomotor tests than FIT.

The results of the studies clearly show that FIT are considerably more difficult to perform than conventional psychomotor tests for all of these groups of drug-free individuals.

However the **main finding** is evident - that the results of the studies lend very powerful support to **Hypothesis 2 (4.4.3.) –**

"FIT are not reliable and valid tests of drug-related impairment to drive and are too difficult for some groups of drug-free individuals to perform".

CHAPTER 5. FIT: General discussion and conclusions.

It is clear from the studies undertaken that considerable numbers of drug-free individuals in each of the three study groups were noted to be unable to perform FIT successfully (Table 4.4) and it is both reasonable and logical to assume there may be factors unrelated to drug use responsible for their lack of ability to successfully perform FIT. It must reasonably be considered possible, that a suspect driver who has performed poorly in these tests might have some naturally occurring problem with balance and co-ordination, or some undiagnosed condition such as dyslexia or dyspraxia, both of which are prevalent in the general population (Smythe 1999; Wassell 2000; POST 2004). Also labyrinthitis, an infection or inflammation of the inner ear, which causes dizziness and loss of balance and is frequently associated with a viral infection such as influenza and the common "cold" can result in poor performance in tests of balance.

We should therefore be mindful of the problems which might be encountered in these tests (FIT) by drug-free individuals who may have a naturally occurring condition leading to difficulties with the seemingly normal process of understanding and remembering a lengthy sequence of several instructions and commands, while assuming a fixed unnatural position, performing unusual and unfamiliar tasks of balance and co-ordination, all the while in a stressful environment.

5.1. Objective analysis of FIT.

It is important to analyse in detail the components of each individual test in FIT and also to consider the implications of how the tests are conducted and how the tests are judged by the police officers and FMEs who use them to assess suspect drug-drivers.

Walk And Turn Test.

a) In this test there are **ten separate instructions,** which the suspect has to remember prior to attempting to follow instructions to the satisfaction of the police officer conducting the test. This will present some individuals with a greater degree of difficulty than others. Indeed it is not considered possible for a dyslexic subject to be able to retain the sequence of information and then recall how to perform the test (Smythe 1999). Dyslexia affects 10% of the population and for this group alone, the Walk and Turn test is entirely inappropriate.

b) Throughout the instruction phase of the test the subject is required to maintain a fixed unnatural balance without moving, with the right foot in front of the left. It is a requirement of the test that the right foot is positioned in front of the left and it is questionable why the suspect is not permitted to assume his preferred position, provided one foot is in front of the other.

c) It is noted that both arms have to be held rigidly at the sides throughout the test. This unnatural position does not assist balance, indeed the converse is the case (c.f. tightrope walker).

d) The suspect is required to watch his/her feet at all times throughout the test. This again is an unnatural position or situation and it does not assist or facilitate balance (c.f. tightrope walker). It in fact makes the procedure more difficult and is unnecessary for accurate assessment of balance.

One Leg Stand Test.

a) This test requires the subject to remember **6 separate instructions** prior to commencing the test, and again subjects with learning difficulties will have considerable problems recalling the sequence of instructions.

b) The requirement for the subject to stand with the leg outstretched and with the sole of the foot elevated 8 inches and parallel to the ground is an unnatural posture to adopt which does not assist or facilitate balance, indeed the reverse is more likely. The question arises why the subject is not permitted to stand with the knee flexed, which would facilitate balance.

c) With both arms fixed to the sides, this is an abnormal posture. The question arises why the subject is not permitted to raise the arms, as long as the balance is seen to be steady (c.f. tightrope walker)?

d) The requirement for the subject to constantly look at the raised foot for a period of 30 seconds is an unnatural posture to adopt and does not assist or facilitate balance; indeed again the reverse is more likely. The question arises is - why looking ahead at a fixed reference point which assists balance (c.f. tightrope walker) is not permitted?

e) The duration of this test of 30 seconds is a long time to adopt this unnatural posture, particularly for an older subject in whom fatigue might influence ability to perform the test, for an overweight individual, or a vulnerable subject in whom anxiety might have an adverse influence.

Finger To Nose Test.

a) This test requires the subject to remember **7 separate instructions** prior to commencing the test, and again persons with learning difficulties will have significant difficulty recalling the sequence of instructions (Smythe 1999).

b) When the test starts the suspect is obliged to tilt his head back and close his eyes, which alters and affects the balance and makes the test more difficult.

c) Having the eyes closed from the outset makes the test more difficult than if initially tested with the eyes open then testing again with the eyes closed.

d) The alteration of sequencing (right, left, right, left, left, right) makes the test more difficult than it need be, particularly in a subject under stress and who has anticipated the systematic alternating process to be continued.

e) Police officers are required to regard any subject who touches the tip of the nose with the pad of the finger to have incorrectly performed the test.

The Romberg Test.

a) This test requires the subject to remember **5 separate instructions** prior to commencing the test, and again persons with learning difficulties will have difficulty recalling the sequence of instructions.

b) Conducting this test with the head tilted back will not facilitate or assist balance - in fact the reverse is likely to be the case. There is no requirement for the head to be tilted backwards for accurate assessment of the test.

5.2. Discussion of Preliminary/Field Impairment Tests.

If one considers comprehensively and dispassionately what exactly Field Impairment Tests (FIT) actually assess, the answer must be that they assess a variety of physical, neurological, intellectual and cognitive functions which interlink information processing, organisational skills, short- term memory, spatial awareness, balance and co-ordination, but not the least, the ability to perform these rigid and complicated tests under stress. However no evidence has been presented that the tasks undertaken in FIT have any relevance to the safe driving of a motor vehicle (Hartley 2001).

There are several conditions which might account for poor performance in FIT which are unrelated to drug use and these include common conditions such as dyspraxia and dyslexia; plus the less common but by no means rare, autistic spectrum disorder such as Asperger's Syndrome. It is important to be aware that these conditions might not be so significantly disabling to the extent that the subject is aware of any specific problem, and their condition might be unrecognised and undiagnosed.

Dyslexia is a not uncommon condition affecting 10% of the population with 4% severely affected although estimates vary between 5% and 15% (Parliamentary Office of Science and Technology 2004). Dyslexia is a specific learning difficulty related to disorder of information processing and apart from causing difficulty with the acquisition of reading, writing and spelling, may encompass some or all of the following – difficulty with organisational skills; making errors with numbers; mistakes with instructions; problems with explaining ideas and concepts; difficulty with orientation; confusing left and right; confusing dates and forgetting appointments (Smythe 1999).

Dyspraxia is a not uncommon condition affecting approximately 10% of the population (Dyspraxia Foundation 2005), which can be defined as motor difficulties caused by perceptual problems, especially visual motor and kinaesthetic motor difficulties (Portwood 1999). It has also been defined as an immaturity of the brain resulting in messages being improperly transmitted to the body. It affects at least 2% of the population in varying degrees and although a genuine disability, those affected do not look disabled. Some of the common problems caused by dyspraxia are – clumsiness; poor posture; awkward gait; poor short-term memory; poor body awareness; poor sense of direction; inability to hop or skip (Wassell 2000).

Asperger's Syndrome (AS) is a relatively rare condition, however the incidence of Asperger's Syndrome in the general population has been estimated at 0.29% to 0.71%, with a 4 to 15-fold predominance in males (Weimer et al. 2001). AS is a pervasive developmental disorder marked by significant impairment in social interaction and restricted or stereotyped interests or behaviours. In addition to the social deficits, Asperger and autistic individuals also exhibit motor control abnormalities such as impaired gait, balance, manual dexterity and grip (Gowen & Miall 2005). Motor impairment has frequently been described and it has been estimated that 80% of subjects with AS display "motor dyspraxia," or clumsiness. Studies have been conducted where a battery of motor tests was administered to subjects with AS and these subjects were found to perform more poorly than controls on tests of apraxia, one-leg balance with eyes closed, tandem gait, and repetitive finger-thumb apposition (Green et al. 2002).

Extreme fatigue, coupled with a degree of sleep deprivation might account for poor performance on these tests. Williamson and Feyer (2000) studied normal subjects and noted that after 17 to 19 hours without sleep, performance on some tests was equivalent or worse than that recorded in the same subjects who had a blood alcohol concentration of 50 mg per 100mls blood. Reaction times were up to 50% slower for some tests and accuracy measurements were significantly poorer.

The relevance and validity of FIT as tests of drug-related impairment of driving ability has been questioned, and whilst confirmed by some investigators (Burns 1995; Burns and Adler 1995; Sexton et al. 2000; Sexton et al. 2002; Collier 2010; North 2010) has been refuted by others (Erwin 1995; Trocino 1997; Head 2001; Hartley 2001; A.F.P. 2003; Johnston and Ramsey 2003; Rubenzer 2008; FFLM in North 2010d; Mercier-Guyon 2010; Stark 2010; Porath-Waller and Beirness 2010; Verstraete and Legrande 2010). Indeed the ability of the tests to withstand challenge in court is a legitimate question which remains to be answered.

Burns (1995) has been widely quoted in her study in which she claims validation for the Standardised Field Sobriety Test (SFST) battery. However her authority has been challenged in court (Trocino 1997).

"It has to be acknowledged the author of the initial studies which tended to validate the DRE programme, Dr Marcelline Burns, was intimately associated with the DRE protocol and involved in the Los Angeles test which "touted" the DRE accuracy".

Furthermore it was found by a New Mexico Court of Appeal (Head 2001) -

"Dr Burns was found to be "not qualified" to testify as an expert witness"

The Transport Research Laboratory Reports TRL 477 and TRL 543 have stated -

"Sobriety tests are of value in deciding whether a participant is impaired. The analysis of the sobriety tests showed that there is validation evidence in this test battery." (Sexton 2000).*"It was judged that the general medical examination and standardised impairment testing applied by the police surgeons were generally effective in determining impairment."* (Sexton et. al 2002).

It is of note however, that the initial report related to cannabis and driving, whereas the more recent report related to the influence of cannabis and alcohol on driving.

Hartley (2001) has given his opinion on FIT –

"It is arguable the SFSTs will be of little assistance in establishing the link between the drug and impaired driving, since the tests do not assess the functions involved in driving."

Johnston and Ramsey (2003) are particularly critical of FIT and have stated –

"No evidence has been presented that there is any correlation between a person's performance on any aspect of the battery of tests used in FIT (Field Impairment Testing) and that person's ability to drive. It is our belief that the use of these tests has led, and will continue to lead, to the arrest and conviction of motorists whose only crime is that they cannot "pass" the FIT procedures."

However most notably and importantly, the professional bodies who are responsible for the education, training, and maintenance of sound professional standards for forensic physicians (FPs) and forensic medical examiners (FMEs) have repeatedly stated that FIT remain yet to be validated as reliable indicators of drug-related impairment of driving ability (AFP 2003; FFLM in North 2010d; Stark 2010). This is of course, in addition to the significant number ($p<0.0001$) of 33% of FMEs survyed, who stated that FIT were too dificult for their stated purpose (Table 3.5.).

A major concern must be that the results of FIT which have been conducted and interpreted by police officers with limited training and without any form of medical experience or qualifications, are led in courts throughout the UK as evidence of imapirment in driving ability due to drugs. This is despite the clear statement from the Research Programme Manager, Head of Impairment Studies, Road Safety Division, Dept for Transport (Read 2003) –

"Field Impairment Tests are not test of impairment to to drive, but part of an assessment by a police officer at the roadside. At the conclusion of this assessment the officer will decide, on everything he knows about the driver, including the performance on FIT, whether there is sufficient evidence to arrest the him or her under Section 4 of the Road Traffic Act".

Poor performance in FIT, presented as evidence of drug-related impairment in driving ability has become established practice and indeed has been accepted, perhaps in part, due to the official sounding name of the tests, however perhaps also to a lack of challenge to the validity of the tests. Certainly in the USA these FIT have been successfully challenged (Erwin 1995; Nowaczyk and Cole 1995; Trocino 1997; Hartley 2001; Head 2001).

5.3. Summary of findings from recent research.

The question of how best to address the problem posed to road safety by drivers of motor vehicles who have taken drugs is extremely complex for a variety of reasons, and subsequently is not easy to answer.

It might be prudent to consider what exactly is known regarding the problem of drugs and driving.

There has been little research into the problem of drug use and driving conducted in recent years in the UK and the level of evidence on drug driving is poor (North Report 2010 c), however a significant body of work has been undertaken throughout member states of the European Union (DRUID 2012). Unfortunately the DRUID research, which encompasses 18 EU member countries, does not include the United Kingdom.

With particular reference to FIT, there are currently no reliable data available and this prevents forming any definite conclusions on the reliability of FIT, since in order to ascertain the effectiveness of FIT it would be necessary to have accurate data on the number of FIT procedures conducted, the number of subjects declared to be impaired by the police officers, the results of toxicological analysis of the blood samples, and also the judicial outcome of the cases involved (North 2010).

The research study "Monitoring the effectiveness of FIT" has reported that FIT may be considered a useful "*screening device"* for suspect drug-drivers (Oliver et al. 2006), however there have been no peer reviewed publications which have validated FIT as tests of drug-related impairment in driving ability (AFP 2003; FFLM in North 2010d; Stark 2010).

FIT/PIT as currently used in the UK has been the subject of criticism from a variety of sources including legal practitioners and toxicologists (Erwin 1995; Nowaczyk and Cole 1995; Trocino 1997; Hartley 2001; Head 2001; Johnston and Ramsey 2003; Rubenzer 2008) however most importantly by the Faculty of Forensic and Legal Medicine (AFP 2003; FFLM in North 2010d; Stark 2010) and a significant percentage ($p<0.0001$) of 33% of Forensic Medical Examiners (FMEs) who responded to the research projects (see chapters 3.1.3; 3.2.3; and 3.3.4.).

The Australian clinical test of impairment (CTI), which has incorporated some aspects of FIT, notably the One Leg Stand Test and the Walk and Turn Test, has been claimed to be a *"moderate predictor of impairment"* following use of THC (Papafotiou et al. 2005). However this opinion must be qualified by the fact that this CTI battery has been subject to the addition of the novel and somewhat subjective sign of "head movement jerks" (HMJ).

Recent expert opinion voiced at the ICADTS T2010 conference in Oslo identified the shortcomings of FIT and indicated the need for a new test battery of CTI to be devised based on a cognitive and behavioural approach, however the basis of the test battery has yet to be devised (Mercier-Guyon 2010; Porath-Waller and Beirness 2010; Verstraete and Legrand 2010).

The North Report (2010) contains claims that FIT has been validated as an effective test of impairment in drug drivers however these claims have only come from police sources (Collier 2010) a former Road Police Training Officer who developed the National Drug Drive Instructor Training for FIT, and who quoted the Florida Validation Study of 1997 in which the study author (Burns 1995) validated her own tests and was regarded as not entirely impartial (Trocino 1997).

The specific research undertaken in this thesis has established clear evidence that some drug-free individuals have difficulty successfully completing FIT, as opposed to conventional psychomotor tests (Table 4.4). These results have validated the opinion of the FMEs surveyed who had stated that they considered FIT too difficult (Table 3.5).

5.4. Proposals to assist in the diagnosis of drug-related impairment.

When we consider FIT/PIT it is clear they have been the subject of criticism (Erwin 1995; Trocino 1997; Head 2001; Hartley 2001; A.F.P. 2003; Johnston and Ramsey 2003; Rubenzer 2008; Mercier-Guyon 2010; Porath-Waller and Beirness 2010; Verstraete and Legrande 2010) and the challenge is to produce a system or method which will eliminate the claimed specific deficiencies and deliver a product which is robust enough to overcome any challenge to its reliability and validity (Wolff 2013).

In essence the process, after due study and trials, must be seen to be and accepted as, "Fit for Purpose". Any new clinical tests of impairment (CTI) should specifically address the activities relevant to the safe operation of a motor vehicle, involving both the cognitive and motor functions including alertness, attention and vigilance; orientation in time, place and person; demeanour and mood; balance and co-ordination and particularly eye-limb co-ordination; reaction time; and dual tasking.

It is essential any new test battery should also include an assessment of the clinically recognised psychological and physiological effects of drugs, including intellectual and cognitive functioning. Therefore an examination for drug-related abnormal findings including deficit in intellectual and cognitive functions, motor co-ordination, and "vital signs" including pulse or heart rate; blood pressure; temperature; and respiratory rate. An examination of the eyes for abnormality in pupil size and reaction to light; lack of convergence; presence of nystagmus or hyperaemia, undertaken by an appropriately trained and skilled professional is considered essential. Finally the manner and content of speech should be assessed.

5.4.1. Proposed Clinical Tests of Impairment (CTI).

The seven sub-groups for clinical examination as detailed (see Table 5.1) are considered highly relevant to the skills necessary for safe driving and would assist in the diagnosis of impairment in ability to drive. The clinical findings in relation to the tests can be noted and referred to, in order to support a diagnosis of either "Evidence of impairment" or "No evidence of impairment".

It is acknowledged that the presence of any individual sign or combination of signs may not provide a definitive diagnosis of current drug effects. However following a detailed and thorough examination, an experienced forensic physician (FP) or forensic medical examiner (FME) should be in a position to come to an appropriate diagnosis regarding the significance of the findings.

Prior to the introduction of FIT (Railways and Transport Safety Act 2003) there was no standardised method or procedure for FMEs to adopt when examining suspect "drug-drivers". In Scotland, Strathclyde Police FMEs used a printed proforma F97 which had been use since the 1970s for the examination and assessment of suspect "drunk-drivers". The problem with the use of form F97 was obvious in that not only had it been produced decades previously, it had been designed to assist the FME in detecting evidence of impairment in psychomotor function which was directly related to the effects of alcohol but not of drugs.

However most FMEs in Strathclyde continued to use the F97 proforma when examining drivers who were suspected of being under the influence of drugs and by doing so they commented on the presence or absence of specific clinical signs which related specifically the effects of alcohol and not the effects of the various drugs used illicitly.

Some drugs, in particular the CNS stimulants, have little or no effect on the suspect driver's ability to perform currently used "Impairment" tests (Mercier-Guyon 2010).

This proposed battery of clinical tests of impairment has been used by myself in forensic clinical practice for approximately 10 years, in the assessment of drug-dependent detainees who had requested medications to ease their claimed "drug withdrawal syndrome", however more importantly as formal tests used in the assessment and examination of suspect "drug-drivers" arrested by police.

Regarding drug-dependent detainees, of whom I have examined several thousand, I have applied these tests as part of my routine, thorough examination process in over one thousand cases. In many cases, poor performance on the tests clearly indicated the acute effects of drug use were still present, and the detainees were advised that they were not "in withdrawal", and their their poor psychomotor function was clear evidence that, at the time of the examination, they were under the influence of drugs.

In respect of suspect "drug-drivers" it is important to realise that the Railways and Transport Safety Act 2003 which introduced FIT into the legislation, made it a requirement for a suspect drug-driver to comply with FIT as conducted by a police officer, however there is no requirement for an FME subsequently called to examine the driver to use FIT as part of the examination process. The FME has clinical independence to conduct whichever examination he or she considers appropriate.

I have used the proposed CTI in approximately 100 cases of suspect "drug-drivers" whom I have examined at the request of the police. I have given evidence in court on countless occasions based on interpretation of these tests (proposed CTI) and have been commended by the court for my assistance into the prosecution of the cases and have never received any adverse criticism. Since 2000 I have been instructed in

almost 100 cases by defence solicitors to study all relevant evidence and provide an independent opinion for the court regarding any correlation between the clinical condition, performance on tests as applied by the FME, and toxicology results of blood samples from the suspect "drug-drivers". I have observed some very poor clinical examination procedures and inappropriate opinions, and noted on several occasions it was simply not possible to explain a link between the clinical evidence recorded by the FMEs and the toxicological results. As a result I became stimulated to devise the proposed CTI, which in my opinion more reliably detect clinical evidence of drug-related psychomotor impairment, and most importantly help to link specific clinical signs to the recognised effects of specific drugs.

Whilst I have used these proposed CTI personally for several years, none are new tests, rather it is the specific combination of the tests which is a new approach.

It is particularly important to highlight that although I used the proposed CTI battery on some detainees and suspect "drug-drivers" during the period in which the research studies were conducted, these proposed tests were conducted in an entirely separate group of detainees from the research study Groups A, B, and C.

For the purpose of absolute clarity it is worth highlighting that the core groups A, B, and C were assessed using strict FIT parameters; FIT minus "clues" or "indicators"; and conventional tests. However these conventional tests were standard basic balance and co-ordination tests, which were entirely different from the proposed CTI.

Table 5.1. Categories for clinical examination in the proposed CTI.

GENERAL OBSERVATIONS			
Drowsiness (extreme)	Present 5	Absent 0	
Confusion	Present 4	Absent 0	
Disinhibition	Present 2	Absent 0	
Mood Swings	Present 2	Absent 0	
Hallucinations	Present 5	Absent 0	
Memory problems	Present 2	Absent 0	
			SCORE = /20
VITAL SIGNS			
Pulse	Abnormal 1	Normal 0	
BP	Abnormal 1	Normal 0	
Temperature	Abnormal 1	Normal 0	
			SCORE = /3
SPEECH			
Slow/ thick/ slurred	Present 1	Absent 0	
Inappropriate/bizarre	Present 1	Absent 0	
			SCORE = /2
EXAM^{N} EYES			
Pupils grossly constricted/dilated	Present 1	Absent 0	
Convergence	Absent 1	Present 0	
Nystagmus	Present 2	Absent 0	
Pupil reaction	Absent 1	Present 0	
Hyperaemia	Present 1	Absent 0	
			SCORE = /6
PHYSICAL SIGNS			
Muscle rigidity	Present 1	Absent 0	
Muscle flaccidity	Present 1	Absent 0	
Reaction time	Abnormal 1	Normal 0	
Obvious Tremor	Present 1	Absent 0	
			SCORE = /4
BALANCE & CO-ORDINATION			
Manages 1 leg stand	No 3	Yes 0	
Manages heel-toe walk	No 3	Yes 0	
Manages Finger-nose	No 3	Yes 0	
			SCORE = /9
ROMBERG TEST			
Sways excessively	Yes 3	No 0	
Abnormal time	Yes 3	No 0	
			SCORE = /6
			TOTAL SCORE = /50

At the conclusion of the examination the FME is more likely to be in a position to state whether the suspect driver has a condition which might be due to the effect of a drug(s) than by use of either the outdated F97 proforma, or indeed FIT. Furthermore the FME is more likely to be in a position to make an informed judgment whether or not the suspect driver shows any evidence of drug-related impairment in driving ability. The FME would be in a position to more accurately identify the causative drug type involved, for example CNS sedatives; CNS stimulants; cannabinoids, or hallucinogens, without having to attempt to identify the specific drug. It must surely be accepted that this more detailed level of clinical evidence would be likely to be more beneficial to the courts and assist them in their judicial responsibilities.

These proposed CTI are of course only in a rudimentary stage of development and are not offered as a final solution. Consultation with other specialists would be vital such that appropriate amendments to both the individual components of the test battery and the scoring scales might be made. Particular weight has been accorded to extreme drowsiness, hallucinations, confusion, disinhibition, mood swings and memory problems, all of which clearly constitute a hazard to safe driving.

5.4.2. Proposed "Aggregate Clinical Score" method.

Although the clinical findings noted in respect of the proposed clinical test battery may be used in general to support a diagnosis of impairment, there may be value in allocating individual "points" for each abnormal finding noted, whereas normal findings would attract a zero score. At the conclusion of the examination, the points allocated to each subject would be accumulated to provide an "Aggregate Clinical Score".

The obvious advantage of such as system is that it has the potential to differentiate individuals who display no, or very few abnormal findings from others who present as grossly abnormal. The current judicial processes take into consideration the level of blood alcohol when a driver is convicted under Section 5 RTA 1988, in relation to the sanctions applied and it would appear reasonable that a similar process should be available in respect of contravention of Section 4 RTA 1988.

A perceived potential disadvantage might be the subject who attracts a relatively low number of "points" and who might be regarded as a "borderline" case. However the forensic physician need only advise the police whether or not the subject has a condition, which might be due to the effect of a drug. Subsequent toxicological analysis of the blood sample would indicate whether or not the subject had recently used drugs.

Such a proposed scoring system would require significant research prior to its introduction since some clinical signs may be of greater significance than others and it would be appropriate to accord a degree of "weighting" to some signs, for example extreme drowsiness, hallucinations, disinhibition, confusion, memory problems and mood swings. For similar reasons it would appear reasonable and logical to accord "weighting" to difficulties with balance and co-ordination tests. In addition, consultation and collaboration with other specialists would guide the process and hopefully facilitate identification of an appropriate and reliable "cut off" score which would indicate a clinical state or condition incompatible with asfe driving.

5.4.3. Proposed 2nd Examination procedure.

Wheatley (2000) gives a detailed account of police powers to detain persons affected by alcohol or drugs in relation to Section 10 RTA in his treatise entitled "Road Traffic Law in Scotland".

He highlights Section 10 of the Road Traffic Act 1988 (as amended by the Road Traffic Act 1991, Sch 4, para 43) as detailed below –

(1) "Subject to subsections (2) and (3) below, a person required to provide a specimen of breath, blood or urine may afterwards be detained at a police station until it appears to the constable that, were the person then driving or attempting to drive a mechanically propelled vehicle on the road, he would not be committing an offence under section 4 or 5 of this Act".

(2) "A person shall not be detained in pursuance of this section if it appears to a constable that there is no likelihood of his driving or attempting to drive a mechanically propelled vehicle whilst his ability to drive properly is impaired or whilst the proportion of alcohol in his breath or urine exceeds the prescribed limit.

(3) "A constable must consult a medical practitioner on any question arising under this section whether a person's ability to drive properly is or might be impaired through drugs, and must act on the medical practitioner's advice."

"This section in effect allows a police officer to detain any motorist who has been required to provide a specimen of breath, blood or urine at the police station until he is satisfied either that, in his opinion, the level of alcohol in the accused's body is such that were he to drive he would no longer be committing an offence or that there is no likelihood of him driving. The decision in these matters is left entirely to the constable in question, and there is no sanction provided by the section in respect of any abuse of power in respect thereof other than by making a complaint in the normal way. However, if the accused's condition arises from the consumption of drugs, the constable is required to seek out a medical practitioner's advice on the question of whether the accused's ability to drive is impaired and, having done so, the constable must act on the advice given."

Police officers throughout the Strathclyde Police Force in Scotland until the late 1990's exercised these powers in respect of drivers who, following examination by the forensic medical examiner (FME), were declared to be impaired in their ability to drive due to the effects of alcohol. Such drivers were detained in custody for a period of approximately 12 hours and were then re-examined by the same FME prior to the driver's release from custody. The FME, as a matter of routine, would complete an additional separate formal medical examination report, which would be submitted to the Procurator Fiscal as further evidence in the prosecution case.

The inference drawn in cases where the driver no longer showed evidence of clinical abnormalities or poor psychomotor performance was that he or she had "sobered up" since the effects of the alcohol had "worn off" naturally. This evidence from the 2nd examination was regarded as highly relevant and valuable to the understanding of the cause of any perceived "impairment" in the suspect driver. Indeed in some cases when the performance at the 2nd examination was found to be virtually identical this was regarded as significant forensic evidence since it pointed to an underlying natural or medical cause of "impairment" as opposed to intoxication.

Since the legislation is currently in place in Scotland it might be appropriate for the authorities to give consideration to the possibility of re-introduction of the 2nd examination as a matter of routine in these "drug-driving" cases. Indeed the BMA has alluded to this (North Report 2010 e) -

"The BMA suggested that it might not be untoward for a doctor to make a later "medical" assessment to exclude a more serious cause of that impairment within a timescale that suited the clinical state of the detainee."

5.4.4. Proposed Independent Expert Forensic Medical Opinion.

Due to the complexities involved in the various processes required for suitable and thorough investigation and appropriate prosecution of "drug-driving" cases, it would be of considerable advantage to have the benefit of an independent expert to advise the courts on the relevance of the findings pertinent to the specific case.

The Faculty of Forensic and Legal Medicine, has stated a role exists for suitably qualified and experienced Forensic Physicians to act as independent "experts" for the Court by reviewing all the evidence of alleged impaired driving including –

- The stated manner of the suspect's driving.
- The recorded findings on FIT.
- The Forensic Physician's assessment.
- The toxicological results.

The independent expert would be required to provide a detailed formal report and provide an opinion on whether or not the alleged manner of driving and the recorded clinical findings of the suspect driver was consistent with the effects normally associated with a person who had used drugs, and, when taken into consideration with the toxicological results, would result in the person being unfit to drive safely.

It may be appropriate for the authorities to consider the instruction of such an expert in all cases where drivers are charged with contravention of Section 4(1) of the Road Traffic Act 1988 – at least for a trial period in the short term.

5.5. Implications of the research findings.

The findings presented in the analysis and discussion chapters of this thesis, and also the process of gathering the data, have enhanced my own understanding, but will hopefully enhance the research literature base in respect of the complex problem which drug use and driving presents to road safety.

Research has established that although FIT may be considered a useful *"screening device"* for suspect "drugs drivers" (Oliver et al. 2006) there have been no peer reviewed publications which have validated FIT as tests of drug-related impairment in driving ability (AFP 2003; FFLM in North 2010d; Stark 2010).

The findings of the research, address the important but as yet unrecognised, or perhaps put more accurately "unaccepted" fact that current UK clinical tests of impairment - specifically FIT (now named PIT) are not tests of impairment to drive - as has been clearly stated by the Research Programme Manager, Head of Impairment Studies, Road Safety Division, Dept. for Transport (Read 2003).

The research undertaken clearly illustrates that FIT, as currently used in the UK, has been justifiably the subject of criticism from a variety of sources including legal practitioners and toxicologists (Erwin 1995; Trocino 1997; Head 2001; Johnston and Ramsey 2003) however more importantly by the Association of Forensic Physicians (AFP 2003) Forensic Medical Examiners (FMEs) (see chapters 3.1.3; 3.2.3; and 3.3.4.) who responded to the postal questionnaire surveys and most importantly the Faculty of Forensic and Legal Medicine (FFLM in North 2010d; Stark 2010).

A crucial factor in the investigation and appropriate prosecution of "drug driving" cases is that the evidence presented to the court must be reliable and robust to the extent that it can withstand vigorous challenge. There is concern that some cases might fail as a result of evidence (of impairment) led in relation to a driver's performance in FIT as gathered by police officers, being rejected as evidence of impairment to safely drive a motor vehicle. These situations could be avoided if new more appropriate and relevant CTI were developed by appropriate specialists, including of course medically qualified "experts" who would be in a position to commend the new test battery for acceptance as a more genuine and reliable clinical test of drug-related impairment of driving ability.

The evidence presented to court may be enhanced, not only by the development and introduction of more relevant CTI, but also by the manner in which the tests are applied and assessed. Consideration ought to be given in relation to the possibility of quantifying the degree of impairment using a diagnostic tool such as the "Aggregate Clinical Score" as has been proposed. The possibility of a 2nd examination would offer further clinical evidence and would have the potential to deliver much greater clinical accuracy in the diagnosis of drug-related impairment to drive opinion.

Finally consideration ought to be given to the use of an independent forensic physician "expert opinion" in all cases such that detailed independent analysis of all relevant evidence can be undertaken prior to the provision of an impartial opinion which would greatly assist the court in coming to an appropriate judgement on drug-related driving impairment.

5.6. Limitations of the research.

The thesis has attempted to highlight the problems and challenges, which must be acknowledged and overcome when attempting to safely and reliably diagnose drug-related impairment of driving ability, by the use of Clinical Tests of Impairment, and FIT/PIT in particular.

The question of whether FIT as used in the UK are sufficiently sensitive, reliable and valid, has I trust, been appropriately addressed and answered.

The question as to which measures might be implemented to facilitate control of this specific hazard to road safety remains to be resolved although specific proposals have been offered.

The new test battery proposed ought to be considered as only the first step in an attempt to deliver a more relevant CTI which would be seen to relate to the driving task since the clinical functions assessed, with the exception of speech and "vital signs", would be regarded as pre-requisites for safe driving. However further development of this proposed new tests battery is required prior to its introduction, and the opportunity to liaise and collaborate with other specialists in this field would be beneficial.

5.7. Final Hypothesis based on research findings.

The aim of this thesis is to investigate the validity of the current Field Impairment Tests (FIT) in relation to their stated function as indicators of impairment in driving ability due to the effects of recent drug use.

Two opposing hypotheses have been tested –

1. **FIT are reliable and valid tests of drug-related impairment to drive - all groups should pass all tests and score equally since all are drug-free.**

2. **FIT are not reliable and valid tests of drug-related impairment to drive - and are too difficult for some groups of drug-free individuals to perform.**

The results of the research studies lend strong support to the assertions of the FMEs surveyed (see chapters 3.1.3; 3.2.3; and 3.3.4) that FIT as currently used are too difficult.

More importantly the study results provide powerful evidence in support of **Hypothesis 2** -

FIT are not reliable and valid tests of drug-related impairment to drive - and are too difficult for some groups of drug-free individuals to perform.

5.8. Future Work.

I have noted with interest that the UK government has recently commissioned the Department for Transport to convene an expert panel to study the available evidence on the problem of "drug-driving" and to submit recommendations regarding the proposed introduction of new legislation in relation to drug use and driving. The Crime and Courts Bill, which was introduced into Parliament in May 2012 makes provision for a new offence of driving, attempting to drive, or being in charge of a motor vehicle with a specified controlled drug in the body above the level specified for that drug. The panel made several recommendations however were clear in their evidence statement - *"There is no universal agreement on how to objectively measure impairment for psychoactive drugs and driving."* (Wolff 2013).

Intriguingly the European Union's research project on Driving Under the Influence of Drugs, Alcohol and Medicines has also recently published its findings and has reported in respect of prescribed drug use - *"Regarding driving under the influence of medicines, attempting to define a legal limit for patients undergoing long-term treatment is inappropriate; sanctions should be based on degree of impairment".* They further recommended in relation to illicit drug use and driving -*"Drug recognition expert programmes and impairment checklists should be improved."* (Druid 2012).

By making these recommendations, both independent bodies have acknowledged that current clinical tests of impairment are less than adequate and require to be improved - and these views support the findings and conclusions of this thesis.

The development of a new battery of clinical tests of impairment, which can be validated, for acute drug effects, remains a priority. The proposed (CTI) as detailed (Table 5.1) is a progressive step forward in the attempt to provide valid and reliable evidence of drug-related impairment in driving ability and further development and refinement of the proposed CTI is an area worthy of further research.

The introduction of a quantifiable assessment of impairment based on the proposed "Aggregate Clinical Score" (Appendix B; Tables 3.1, 3.2; Appendix C; Tables 3.15, 3.6, 3.17) is worthy of consideration and is a concept, which would be worthy of future research. Subjects who have performed reasonably well in the tests but have had minor problems or difficulties could easily be distinguished from those who have shown gross incapacity in performing the tests. Use of such a system is entirely likely to assist the courts in determining the relevance of the toxicological analysis of the blood sample provided by the suspect driver.

Engagement with legislators regarding the possibility of adopting change in the procedure in which suspect "drug-drivers" are clinically examined, and in particular the re-introduction of a 2nd examination (Appendix B; Tables 3.1, 3.2) ought to be explored. The ability to compare performances has been proven to be extremely valuable in the interpretation of the clinical findings in respect of impaired driving due to the adverse psychoactive effects of alcohol, and it is entirely logical and reasonable to anticipate a similar positive contribution in respect of drugs.

Notwithstanding the previous proposals suggested, I would consider the greatest benefit to the investigation of any suspect "drug-driver" would be the involvement of an expert such as a suitably qualified forensic physician (FP), who would be required by the courts to study all relevant evidence including police reports; "impairment tests"; FME reports; toxicological evidence; and any further relevant medical evidence; and thereafter provide an independent opinion regarding the relevance of all findings.

It is of course acknowledged that the final judgement regarding impairment of driving ability due to drugs is a judicial decision, however bearing in mind the questions regarding the reliability and validity of current clinical tests of impairment, and FIT in particular, the provision of such an independent expert opinion is likely to be of assistance to the courts and is surely worthy of consideration by legislators.

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APPENDIX A. FIT form used in the U.K.

IMPAIRMENT ASSESSMENT

Section 3A/4 RTA 1988

INTRODUCTION AND GENERAL GUIDANCE

Note: This form is for use by authorised police officers during the application of Field Impairment Tests on a subject who has voluntarily agreed to participate. Where a test is abandoned the reasons should be recorded in additional particulars. If the questions are read from a laminated card, the wording must be identical to those in this form and the card must remain available for court purposes.

REQUEST AND CAUTION

"In order to assess whether your ability to drive is impaired, I would like you to perform a series of tests. The tests are simple and will enable me to make a judgement as to whether your ability to drive is impaired. I must caution you that you are not required to participate; if you do, the results of the tests may be used in evidence. Part of the evaluation is based on your ability to follow my instructions. If you do not understand any of the instructions, please tell me so that I can clarify them.

'Do you understand' **YES / NO**

'Do you agree to participate in the tests' **YES / NO**

RELEVANT DETAILS

BRIEF CIRCUMSTANCES OF INCIDENT / DEMEANOUR / BEHAVIOUR OF SUSPECT

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

NAME _____ **D.O.B.** _____ **SEX: MALE** ☐ **FEMALE** ☐

ADDRESS _____

DAY/DATE _____ **TIME STARTED** _____

LOCATION _____

WEATHER	FINE ☐	RAIN ☐	SNOW ☐	WIND ☐			
LIGHTING CONDITION	DAYLIGHT ☐	TWILIGHT ☐	DARKNESS ☐				
STREET LIGHTING	LIT ☐	UNLIT ☐	NIL ☐				
ROAD SURFACE	WET ☐	DRY ☐					
FOOTWEAR	SUITABLE ☐	UNSUITABLE ☐	REMOVED ☐				

If unsuitable state reason: . . . . . .

. . . . . .

. . . . . .

. . . . . .

PUPILLARY EXAMINATION

' I am going to examine the size of your pupils, comparing them to this gauge, which I will hold up at the side of your face. All I require you to do is look straight ahead and keep your eyes open'.

'Do you understand?' **YES / NO**

'Are you wearing contact lenses?' **YES / NO**

PUPIL SIZE LEFT: CONSTRICTED / NORMAL / DILATED Approx Size: ☐

PUPIL SIZE RIGHT CONSTRICTED / NORMAL / DILATED Approx Size: ☐

NOTE CONDITION OF EYES: WATERY **YES / NO** REDDENING **YES / NO**

Additional Comments

. . . . . .

. . . . . .

. . . . . .

ROMBERG TEST

'Please stand with your heels and toes together with your arms down by your sides. ***(Demonstrate).*** *Maintain that position while I give you the remaining instructions. Do not begin until I tell you. When I tell you, tilt your head back slightly, close your eyes* ***(Demonstrate - do not close your eyes).*** *When you think that 30 seconds have elapsed, bring your head forward, open your eyes and say "stop".'*

'Do you understand?' **YES / NO**

'Do you have a disability or medical condition that prevents you from participating in this test?' **YES / NO**

'Tilt you head back, close your eyes - begin'

ABLE TO BALANCE DURING INSTRUCTIONS? YES / NO

IF NO STEPS ☐ SWAYS ☐ RAISE ARMS ☐

COMPLIED WITH INSTRUCTIONS? YES / NO

IF NO	EYES OPEN	HEAD RAISED	STEPS	SWAYS	RAISE ARMS
TIME (secs)					

ESTIMATION OF 30 SECS @ ☐

Additional Comments

. . . . . .

. . . . . .

. . . . . .

WALK AND TURN TEST

'Please put your left foot on the line, place your right foot in front of your left foot, touching heel to toe with your arms down by your side. ***(Demonstrate).*** *Maintain that position while I give you the remaining instructions. Do not begin until I tell you.'*

"When I tell you, take nine heel to toe steps along the line, on each step, the heel of the foot must be placed against the toe of the other foot ***(Demonstrate).*** *On the ninth step, leave the front foot on the line and turn round using a series of small steps with the other foot* ***(Demonstrate).*** *After turning, take another nine heel to toe steps along the line. During the test, keep your arms by your sides, watch your feet, count the steps out loud and don't stop walking until the test is complete'.*

'Do you understand?' **YES / NO**

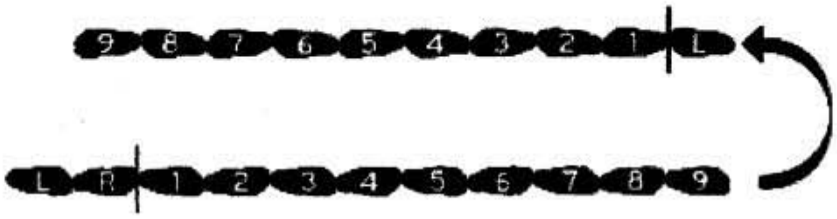
Do you have a disability or medical condition that prevents you from participating in this test? **YES / NO**

ABLE TO BALANCE DURING INSTRUCTION? YES / NO

IF NO STEPS ☐ SWAYS ☐ RAISE ARMS ☐ STARTS TOO SOON ☐

ABLE TO BALANCE DURING INSTRUCTION? YES / NO

COMPLIED WITH INSTRUCTIONS? YES / NO IF NO:



Any deviation from the instructions should be indicated below and on the diagram above.

STOPS WALKING [1] MISS HEEL/TOE [2] RAISE ARMS [3] STEP OFF LINE [4]

CORRECT TURN? YES / NO IF NO STATE REASON:

_____

_____

COUNTS OUT LOUD YES / NO

CORRECT STEP COUNT? YES / NO

If no: TO TURN ☐ **FROM TURN** ☐

Additional Comments

. . . . . .

. . . . . .

. . . . . .

. . . . . .

ONE LEG STAND

'Please stand with your heels and toes together with your arms down by your sides ***(Demonstrate).***
Maintain that position while I give you the remaining instructions. Do not begin until I tell you'.

'When I tell you, raise your right foot approximately six inches off the ground, keeping your legs straight and your toes pointing forward ***(demonstrate).*** *Keep your arms by your sides, look at your elevated foot and count out loud "1001,1002,1003" and so on until I tell you to stop.'*

Do you understand?' **YES / NO**

Do you have a disability or medical condition that prevents you from participating in this test?' **YES / NO**

(Time 30 seconds)

REPEAT FOR OTHER FOOT.

ABLE TO BALANCE DURING INSTRUCTION? **YES / NO**

IF NO: STEPS ☐ SWAYS ☐ RAISE ARMS ☐

COMPLIED WITH INSTRUCTIONS? **YES / NO**

LEFT LEG TIME (secs)	SWAY	HOP	FOOT DOWN	RAISE ARMS

RIGHT LEG TIME (secs)	SWAY	HOP	FOOT DOWN	RAISE ARMS

COUNTED CORRECTLY? **YES / NO**

Additional Comments

. . . . . .

. . . . . .

. . . . . .

. . . . . .

FINGER TO NOSE TEST

Please stand with your heels and toes together with your arms down by your sides. ***(Demonstrate).*** *Extend both arms forward, palm side up, make fists and extend both index fingers. Lower your arms to the side. Maintain that position while I give you the remaining instructions. Do not begin until I tell you. When I tell you, tilt your head back slightly, close your eyes and lift your arms slightly in front of you* ***(Demonstrate).*** *I will say either left or right, at which time lift the relevant hand directly in front and touch the tip of your nose with the tip of the index finger. After touching the nose lower the hand until I tell you the next hand to use* ***(Demonstrate).***

Do you understand' **YES / NO**

Do you have a disability or medical condition that prevents you from participating in this test? **YES / NO**

ABLE TO BALANCE DURING INSTRUCTION? **YES / NO**

IF NO: SWAYS ☐ STEPS ☐ RAISES ARM ☐

Tilt your head back, close your eyes and bring your hands slightly forward

Call out the hands in the following order: left, right, left, right, right, left.

TOUCH	CORRECT	WRONG HAND	MISSED NOSE
1			
2			
3			
4			
5			
6			

COMPLIED WITH INSTRUCTIONS? **YES / NO**

IF NO SWAYS ☐ STEPS ☐ RAISES ARM ☐

ADDITIONAL COMMENTS

. . . . . .

. . . . . .

. . . . . .

TIME TEST COMPLETED ☐

TEST RESULTS: **SUSPECT IMPAIRED/NOT IMPAIRED**

OFFICER CONDUCTING TEST
(Print name and sign) ☐

OFFICER CORROBORATING TEST
(Print name and sign) ☐

ARRESTING OFFICERS ☐

☐

THE WALK AND TURN TEST:
The Walk and Turn test is a test, which divides the subject's attention between balancing and information processing. It comprises two elements- **Instruction** and **Walking**. The test requires the subject to assume a starting position while receiving instructions for the test.

The procedure for conducting the walk and turn test is as follows.

1. Have the subject stand erect with his/her feet together and hands hanging down by their side. Have the subject place his/her left foot on the line, then place the right foot on the line directly in front of the left foot, with the heel of the right foot touching the toes of the left foot (demonstrate). Tell the subject to remain standing in this position while listening to the instructions and not to start the test until you tell them to do so. If the subject loses balance three times in this position, discontinue the test and go on to the next test.
2. Tell the subject when you tell them to start they are to take 9 steps in a straight line touching heel to toe with his/her hands down at their sides, turn about pivoting on their lead foot and taking half steps in a half circle to their left (demonstrate), then take another 9 steps in the same manner. Tell them as they take each step they are to watch their feet, count each step out loud, and not stop until they have completed the test. Demonstrate this for them as you explain.
3. Ask the subject if they understand the instructions.
4. Have them perform the test.

Note if the subject: a. Breaks away from the start up stance; **b**. Starts walking too soon; **c.** Fails to touch heel to toe (note which step); **d.** Steps off the line (note direction and which step); **e.** Stops walking too soon (note which step); **f.** Raises the arms out to the sides; **g.** Takes more or less than 9 steps (note how many); **h** Turns improperly (i.e. the wrong way); **i.** Fails to follow instructions.

From these "indicators" as listed above N.H.T.S.A. (National Highway Traffic Safety Administration) guidelines are that if 2 out of the above indicators are present, this would tend to indicate impairment.

ONE LEG STAND TEST.
This test divides the subject's attention and comprises two elements – **Instruction**; plus **Balancing and Counting**.
During the instruction stage the subject stands straight with his/her feet together and arms by the side. During the balancing and counting stage the subject stands on one leg with the other held straight out, off the ground for a period of 30 seconds.

The procedure for the One Leg Stand test is as follows.

1. Have the subject stand erect with arms at sides.
2. Instruct them not to start until advised and listen carefully to the instructions.
3. Check the subject understands.

4. Tell the subject when you say start, he/she must raise the right foot 6 to 8 inches off the ground keeping the leg straight and the toes pointing forwards, with the foot parallel to the ground. **Demonstrate**.
5. Tell the subject he/she must keep the arms at the side and must keep looking at the elevated foot, while counting out loud in the following manner " 1001, 1002, 1003" and count for 30 seconds. After that tell the subject to stop.
6. Ask the subject if they understand the instructions.
7. Tell the subject to start.
8. Repeat for the other leg.

Note if the subject: a. Sways while balancing; **b**. Raises the arms to maintain balance; **c.** Hops; **d.** Places foot on the ground.
There are 4 indicators – N.H.T.S.A. guidelines are that 2 out of 4 indicate impairment.

FINGER TO NOSE TEST.
This test assesses co-ordination and depth perception. It comprises of two elements – **Instruction** and **Command**. During the instruction phase the subject is told to stand upright with his/her feet together. The subject is told to extend both closed fists, palm side forward, in front of them. During the command phase the subject is told to touch the tip of the nose with the tip of the index finger.

The procedure is as follows :
1. Tell the subject to stand with feet together and arms at the sides.
2. Tell the subject to extend both closed fists, palms up out in front, extend index finger of each hand, then hold index fingers in that position and place the hands palm side forward at the sides.
3. Tell the suspect to maintain that position while you give instructions and not to start until told to do so – emphasise this clearly.
4. Tell the subject when you say start he/she must tilt the head back slightly, close the eyes and lift the arms slightly in front of them with index fingers extended. **Demonstrate**.
5. Tell the subject you will say either left or right at which time he/she should move the hand indicated directly in front with the tip of the finger touching the tip of the nose. The hand should then be lowered and the subject wait until the next hand is indicated. **Demonstrate.**
6. Check that the subject understands.
7. Tell subject to tilt head back, close eyes, and bring hands slightly in front as previously shown.
8. Call out the following hands in the following order.
   Left ; Right ; Left ; Right ; Right ; Left.

Clues : Where tip of index touches ; Which hand used ; Body sway.

THE ROMBERG TEST.

This test is an indicator of the subject's internal clock and body sway. It comprises of two stages – **Instruction** and **Performance**. During the instruction stage the subject must stand upright with the hands hanging by the sides. During the performance stage the subject must stand in the start position with the head tilted slightly back and the eyes closed.

The procedure is as follows:

1. Tell the subject to stand straight with feet together and hands by their sides.
2. Tell the subject to maintain that position while you give instructions. Emphasise he/she should not begin until you say start.
3. Tell the subject that, when you tell them to, they must tilt their head back slightly and close their eyes. **Demonstrate**. Tell the subject to mentally estimate 30 seconds. Tell them at the end of 30 seconds they are to open their eyes and say " time up **". Do not tell them to count**.
4. Ask if the subject understands the instructions.
5. Instruct the subject to begin the test. Time the subject's time estimation with your watch.

An estimation of between 20 and 40 seconds is regarded as acceptable. The test is terminated if 90 seconds elapse or if the subject cannot safely complete the test.

Romberg Test – Clues:

1. Subject unable to stand still or steady with feet together.
2. The time lapse is inappropriate or unacceptable.
3. The subject fails to follow instructions.

APPENDIX B.

FIT QUESTIONNAIRE - STRATHCLYDE FMEs - SURVEYS 1 AND 2.

The purpose of this questionnaire is solely to gauge the consensus of opinion within the audience in respect of the above.

There are no right or wrong answers however each and every response is of value.

1. Do you consider the tests as outlined and recommended to us for adoption as standard procedures, are, or may be regarded as -

(i) more difficult than they need to be? YES / NO

(ii) more harshly or critically assessed than they ought to be? YES / NO

2. **Walk & Turn Test:** considering the test as outlined and the recommendation this test be adopted as a matter of routine, are you –

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

3. **One Leg Stand Test:** considering the test as outlined and the recommendation this test be adopted as a matter of routine, are you -

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

4. **Finger Nose Test:** considering the test as outlined and the recommendation this test be adopted as a matter of routine, are you –

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

5. **Romberg Test:** considering the test as outlined and the recommendation this test be adopted as a matter of routine, are you -

(i) happy to accept in full ? YES / NO

(ii) prepared to accept with reservations ? YES / NO

(iii) unhappy to accept even with reservations ? YES / NO

6. **Section 4 R.T.A. 2nd Examinations:** In previous years when a suspect driver was found to be impaired, Form F97 was completed with appropriate findings listed. The suspect driver was detained in custody for some 8 to 12 hours, then subsequently re-examined, almost always with the absence of previously noted signs of impairment.

Do you consider a second examination of suspect initially found impaired –

(i) Essential? YES / NO

(ii) Worthwhile? YES / NO

(iii) Worthless? YES / NO

(iv) Absolutely contra-indicated? YES / NO

7. **Overall Assessment of impairment / lack of impairment :**

Do you feel there would be any merit in developing and adopting a procedure whereby clinical signs which may be consistent with impairment due to drugs, are individually scored and aggregated, resulting in a grand total score for each suspect?

Low score = normal or no impairment.

Intermediate score = borderline or possible impairment.

High score = definite impairment.

Would you consider a clinical sign **aggregate score** system of value? YES/NO

How many years experience as a police surgeon do you have? 0 - 5 Years

6 - 10 Years

11 - 20 Years

20 + Years

Do you have a post grad qualification such as – D.M.J. ? YES / NO

D.F.M. ? YES / NO

Thank you for completing this questionnaire.

APPENDIX C.

FIT - QUESTIONNAIRE OF APS / UK FMEs - SURVEY 3.

The purpose of this questionnaire is solely to gauge the consensus opinion of registered members of the Association of Police Surgeons in respect of the above tests. The tests will be considered in general, however also individually.

Please feel free to comment on any aspect of the tests or of the questionnaire.

There are no right or wrong answers; however each and every response is of value.

Please indicate your response by circling appropriate answer.

How many years experience as a police surgeon do you have? 0 – 5 Years

6 – 10 Years

11 – 20Years

20+ Years.

Do you have a post graduate qualification such as – D.M.J.? YES / NO

D.F.M. ? YES / NO

Are you regularly engaged in general police work? YES / NO

If NO - please return the questionnaire without completing it - since your response is of statistical value and interest. Thank you.

If YES - are you familiar with the Field Impairment Tests (FIT) ? YES / NO

A full account of the Standardized Field Sobriety Tests / FIT is enclosed at the end of this questionnaire, should you wish to refer to these.

QUESTIONS.

1. **How difficult do you think the tests in general are for suspect drivers to perform?**

1	2	3	4	5
Much easier than they should be	**Easier than they should be**	**About right**	**More difficult than they should be**	**Much more difficult than they should be**

2. **What is your opinion of the standards for assessing the tests in general?**

1	**2**	**3**	**4**	**5**
Much too harsh/critical	**Slightly too harsh/critical**	**About right**	**Slightly too easy**	**Far too easy**

3. **Walk & Turn Test:** considering the test as outlined do you consider it?

1	**2**	**3**	**4**	**5**
Much easier than it should be	**Easier than it should be**	**About right**	**More difficult than it should be**	**Much more difficult than it should be**

4. **One Leg Stand Test:** considering the test as outlined do you consider it?

1	**2**	**3**	**4**	**5**
Much easier than it should be	**Easier than it should be**	**About right**	**More difficult than it should be**	**Much more difficult than it should be**

5. **Finger Nose Test:** considering the test as outlined do you consider it?

1	**2**	**3**	**4**	**5**
Much easier than it should be	**Easier than it should be**	**About right**	**More difficult than it should be**	**Much more difficult than it should be**

6**. Romberg Test:** considering the test as outlined do you consider it?

1	2	3	4	5
Much easier than it should be	**Easier than it should be**	**About right**	**More difficult than it should be**	**Much more difficult than it should be**

7**. Overall Assessment of impairment / lack of impairment :**

Do you feel there might be merit in adopting a procedure whereby clinical signs which may be consistent with impairment due to drugs, are individually scored and aggregated, resulting in a grand total score for each suspect?

Low score = normal / no impairment.

Intermediate score = borderline / possible impairment.

High score = definite impairment.

Would you consider a clinical sign aggregate score system of value?

YES / NO

COMMENTS.

Thank you for completing this questionnaire.

APPENDIX D.

SECTION 4 RTA PROCEDURE: PRO-FORMA AFP & FFLM.

INTRODUCTION AND GENERAL GUIDANCE

Note: This form has been designed by Dr Ian F Wall on behalf of the Education and Research Committee of the Association of Police Surgeons for use by Police Surgeons (also known as Forensic Medical Examiners or Forensic Physicians) who have been trained in the use of Standardised Impairment Tests. The form is provided to assist Police Surgeons in
determining whether a person has a condition which may be due to drink or drugs and not
necessarily due to 'impairment'. It is to be regarded as an aide-memoire and it is therefore not necessary for all parts of the form to be completed. Some details are included so as to aid possible subsequent assessment of fitness for detention in custody. Where a test is abandoned the reasons should be recorded in Additional Particulars at G12. If the questions are read from a card, the wording should be identical to those used in this form and the card must remain available for production at court. On completion this form is the personal property of the examining doctor.

GENERAL DETAILS

Name: Police station:
Address: Custody record No:
Date of birth:
Occupation:
Arrest date: Arrest time:
Time called:
Time arrived:
Time examination started:
Time examination completed:

BACKGROUND INFORMATION

Road side breath test: Intoximeter readings:
Information from arresting officer (PC..……)…….
…….
Field impairment test results...…….
…….
…….
Information from Custody Officer (PS……..)…….….
……
Dr's name……..Date……. * Delete as Applicable Page 2

CONSENT

Consent witnessed by:
"My name is Dr. ……. and I have been asked to examine you to ascertain whether in my opinion, you have a condition which might be due to drink or drugs. You should be aware that any conversation with me might not be treated confidentially. Do you agree to a medical examination?" ***YES/NO**
If **NO** make observations of accused's behaviour:…….
…….
If **YES**, consider written consent:
I consent to a medical examination as explained to me above:
Signed……...

MEDICAL CONSULTATION

Consultation commenced at: Hours

History of recent events:……..……
…….
Current medical problems:…..…….…….....
.....……..…….....
.....…….....……
Past medical history:…..…….....……..……
…….
……...……..…….

HEARING PROBLEMS
BALANCE PROBLEMS
VISUAL PROBLEMS
ASTHMA, DIABETES, EPILEPSY
RENAL IMPAIRMENT
HEPATIC IMPAIRMENT

Alcohol intake and times in last 24 hours:…...…….……
…….
WEEKLY ALCOHOL INTAKE Units per week
TIME LAST ATE
TIME LAST SLEPT

Past psychiatric history:…..…….…….
…….
…….…
Previous self harm attempts:…….…...…
……..
Social history:……...
……..
Relevant educational history (to assess if learning disability etc):……..
……..

MEDICATION DOSE DURATION ROUTE
LAST TAKEN

Prescribed
OTC medicines
Non-prescribed

MEDICAL EXAMINATION

EXAMINED IN PRESENCE OF:

General demeanour:…..…….…….……..…
…….
State of clothing:…..…….……...…….……
…….……
Mental state:…..…….……...…….……...…
…….…
……...…..…….……...…….……
…….……
Specimen of handwriting:…..…….……...…….……..……

…….……..…
SPEECH MOUTH
BREATH
BLOOD
SUGAR
DRUG MISUSE
CVS
RS
GIT

Needle marks: Initial pulse: PN: Soft:
Shivering: BP: BS: Tender:
Yawning: Temp: Added sounds: LKKS:
Rhinorrhoea: Heart sounds: VR: BS:
Gooseflesh: PEFR:
Lachrymation:
Other abnormal findings:…….....
……
. ……..

EYE EXAMINATION
Use the gauge below or a printed laminated card to assess pupil size:

EYE SIGNS RIGHT LEFT
Conjunctiva
Pupil Size
Direct reflex
Indirect reflex
Visual acuity:
Visual fields:
Horizontal gaze nystagmus
Lack of smooth pursuit
Vertical gaze nystagmus: *YES/NO Convergence: *YES/NO
Spectacles: *YES/NO Contact lens: *YES/NO
Other abnormal eye findings:…….……...……...

IMPAIRMENT TESTS
"I would like you to perform a series of tests to enable me to ascertain whether you have a condition which might be due to drink or drugs, or whether your ability to drive is impaired by drink or drugs. The tests are simple and part of my evaluation will be based on your ability to follow instructions. If you do not understand any of the instructions, please tell me so that I can clarify them."

Dr's name……..Date……. * Delete as Applicable

ROMBERG TEST

"*Stand up straight with your feet together and your arms down by your sides. Maintain that position while I give you the remaining instructions. Do not begin until I tell you to do so. When I tell you, you must tilt your head back slightly and close your eyes* ***(demonstrate but do not close your eyes).*** *Keep your head tilted backwards with your eyes closed until you think that 30 seconds have passed, then bring your head forward and say 'Stop'".*
"Do you understand?" **YES/NO***
ABLE TO STAND STILL DURING INSTRUCTIONS: *YES/NO
EXCESSIVE BODY SWAY SEEN: *YES/NO
INTERNAL BODY CLOCK: 30SECONDS AT ……..SECS
How long was that?……
ABLE TO COMPLETE TEST: *YES/NO
COMMENTS:
Front/Back view (Indicate direction & degree of sway)
Side view (Indicate direction & degree of sway)

WALK AND TURN TEST

Identify a real or imaginary line.
"Place your left foot on the line. Place your right foot on the line in front of your left touching heel to toe ***(demonstrate).*** *Put your arms down at your sides and keep them there throughout the entire test. Maintain that position whilst I give you the remaining instructions".*
"Do you understand?" **YES/NO***
"When I say start, you must take nine heel to toe steps along the line. On each step the heel of the foot must be placed against the toe of the other foot ***(demonstrate).*** *When the ninth step has been taken, you must leave the front foot on the line and turn around using a series of small steps with the other foot. After turning you must take another nine heel to toe steps along the line. You must watch your feet at all times and count each step out loud. Once you start walking do not stop until you have completed the test".*
"Do you understand?" **YES/NO***

Any deviation from the instructions and any observations should be indicated below and on the diagram above

Able to stand still during instructions: *YES/NO
Start too soon: *YES/NO Stops walking: *YES/NO
Turn: Correct/Incorrect
Misses heel/toe: *YES/NO Steps off line: *YES/NO
Raises arms: *YES/NO Correct step count: *YES/NO
Notes:

L R 1 2 3 4 5 6 7 8 9

9 8 7 6 5 4 3 2 1 L

ONE LEG STAND TEST

"Stand with your feet together with your arms down by your sides. Maintain that position while I give you the remaining instructions. Do not begin until I tell you to start."

"Do you understand?" **YES/NO***

"When I tell you to start you must raise your right foot six to eight inches off the ground, keeping your leg straight and your toes pointing forward, with your foot parallel to the ground ***(demonstrate).*** *You must keep your arms by your sides and keep looking at your elevated foot while counting in the following manner, 'one thousand and one, one thousand and two' and so on until I tell you to stop."*

"Do you understand?" **YES/NO***

Repeat procedure with each foot

SWAYS - YES/NO
HOPS - YES/NO
PUTS FOOT DOWN - YES/NO
RAISES ARMS - YES/NO

*** If YES, record at what point(s) in the count that it occurred i.e. one thousand and six (1006)**

FINGER AND NOSE TEST

"Stand with your feet together and your arms in this position. ***(Demonstrate extending both hands out in front, palms side up and closed with the index finger of both hands extended).*** *Maintain that position while I give you the remaining instructions. Do not begin until I tell you to start. When I tell you to start you must tilt your head slightly backwards* ***(demonstrate)*** *and close your eyes. When I tell you which hand to move, you must touch the tip of your nose with the tip of that finger and lower your hand once you have done so* ***(demonstrate).***

"Do you understand?" **YES/NO***

Call out the hands in the following order, left, right, left, right, right, left

EXCESSIVE BODY SWAY: YES/NO
CORRECT HAND USE: YES/NO
ADDITIONAL COMMENTS:
Draw lines to spots touched

ADDITIONAL PARTICULARS (see notes at G1).

……

……

FINAL PULSE:
CONSULTATION ENDED AT: hours
CONCLUSIONS

Is the person fit to be detained? *YES/NO
If **NO** make note of reasons and subsequent action…….
…….
Is there a condition present which might be due to a drug?" *YES/NO
If **YES** make note of conditions:…….

POLICE OFFICER ADVISED THAT A CONDITION PRESENT THAT MIGHT BE DUE TO A DRUG AT: hours
Is there impairment present?" *YES/NO
If **YES** make note of reasons:…….
…….
If there is a condition present which might be due to a drug the police officer will proceed as on Form MG DD/B at B18.

SUBSEQUENT PROCEDURES
B9 Blood/Urine Option
Are there medical reasons for the sample not to be of blood? ***YES/NO**
If **YES** make note of reasons (PC will then proceed at B14 Urine option):...….
……..

CONSENT FOR BLOOD SAMPLE
This section continues from B10, B12 and B13 on Form MG DD/B.
Consent witnessed by:
"My name is Dr. ……. and I have been asked to take a sample of blood from you which will be tested for alcohol and drugs"
"Do you agree to a blood test?" ***YES/NO**
If **NO ask:***"Is there any medical reason why I should not obtain a sample of blood from you?"*

Make notes of accused's reasons:……..……...

If **YES,** details as below:
Blood specimen successfully taken at……hours
Site…….. Venting needle used? ***YES/NO**
Blood specimen given to PC…….. at……..hours
If venepuncture unsuccessful, reasons:…….
……..…
……...(Police can still proceed with urine option at B14 on form MG DD/B).
It is also useful to assist the Police Officer in completion of Form MG DD/E Drugs Sample Information Form.

Dr's name……..Date……. * Delete as Applicable
MEDICAL ASSESSMENT FORM MG DD/G

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APPENDIX E.

CLINICAL HISTORY TAKEN FROM SUBJECTS IN GROUPS A, B and C.

Detailed enquiry is made in respect of –

Current health - dizzy, lightheaded, headache, migraine?

- breathing problems, shortness of breath?
- recent injuries, particularly to arms or legs?
- abdominal pain, nausea or vomiting?

Recent health - change in health?

- accidental injuries?

Medical history - hospital admissions?

- hospital out-patient clinics?
- asthma, diabetes, epilepsy, visual problems, hearing problems?
- anxiety, depression?

Prescribed drugs - record all medications taken including last dose

Over the counter - record all medications taken including last dose

Illicit drugs - record all drugs taken including last dose

Alcohol - record daily/weekly intake including time of last drink

APPENDIX F. RESULTS OF RESEARCH GROUP A ("Withdrawals").

		Walk and Turn Test			One Leg Stand Test			Finger - Nose Test			Romberg Test		
		FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv$^{ntl.}$ test	FIT	FIT minus clues	Conv$^{ntl.}$ test	FIT	FIT minus clues	Conv$^{ntl.}$ test
No	**Age**	**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**		
1	24	0	0	1	0	0	1	0	1	1	1	1	1
2	21	1	1	1	0	1	1	1	1	1	1	1	1
3	29	0	1	1	0	0	1	0	1	1	1	1	1
4	33	0	1	1	0	0	1	0	1	1	1	1	1
5	19	0	0	1	0	0	1	0	1	1	1	1	1
6	22	1	1	1	1	1	1	0	1	1	1	1	1
7	24	0	0	0	0	0	1	0	1	1	0	1	1
8	27	0	0	1	0	0	1	0	1	1	1	1	1
9	33	0	0	1	0	0	1	0	1	1	1	1	1
10	26	1	1	1	0	0	1	1	1	1	1	1	1
11	37	0	0	1	0	0	1	0	1	1	0	1	1
12	29	0	1	1	0	0	1	0	1	1	1	1	1
13	32	0	0	0	0	0	0	0	1	1	1	1	1
14	27	0	0	1	0	0	1	0	1	1	1	1	1
15	22	1	1	1	1	1	1	0	1	1	1	1	1
16	34	0	0	1	0	0	1	0	1	1	1	1	1
17	26	0	0	0	0	0	1	0	1	1	1	1	1
18	35	0	1	1	1	1	1	0	1	1	1	1	1
19	28	0	0	1	0	0	1	0	1	1	0	1	1
20	29	1	1	1	1	1	1	1	1	1	1	1	1
21	19	0	0	1	0	0	1	0	1	1	1	1	1
22	27	0	0	0	0	0	0	0	0	0	0	0	0
23	38	1	1	1	0	0	1	0	1	1	1	1	1
24	26	0	0	1	0	0	1	1	1	1	1	1	1
25	30	0	0	0	0	0	1	0	1	1	1	1	1
26	33	0	0	1	0	0	1	0	1	1	1	1	1
27	24	1	1	1	0	1	1	1	1	1	1	1	1
28	28	0	0	1	0	0	1	0	1	1	0	1	1
29	33	0	0	0	0	0	1	0	1	1	1	1	1
30	27	1	1	1	1	1	1	0	1	1	1	1	1
31	35	0	0	1	0	0	1	0	1	1	1	1	1
32	21	1	1	1	0	1	1	1	1	1	1	1	1
33	19	0	0	0	0	0	0	0	0	1	0	0	1
34	44	0	0	1	0	0	1	0	1	1	1	1	1
35	23	1	1	1	0	1	1	0	1	1	1	1	1
36	27	1	1	1	1	1	1	1	1	1	1	1	1
37	34	0	0	1	0	0	1	0	1	1	1	1	1
38	22	0	0	1	0	0	1	0	1	1	0	1	1
39	27	1	1	1	1	1	1	1	1	1	1	1	1
40	25	0	0	1	0	0	1	0	1	1	1	1	1
41	30	0	1	1	0	0	1	0	1	1	1	1	1
42	21	0	0	1	0	0	1	0	1	1	0	1	1
43	26	0	0	1	0	0	1	0	1	1	1	1	1
44	31	1	1	1	1	1	1	1	1	1	1	1	1
45	25	0	0	0	0	0	0	0	0	1	0	0	1
46	20	0	1	1	0	0	1	0	1	1	1	1	1
47	19	0	0	1	0	0	1	0	1	1	1	1	1
48	29	0	0	1	0	0	1	0	1	1	1	1	1
49	34	1	1	1	1	1	1	1	1	1	1	1	1
50	18	0	0	1	0	0	1	0	1	1	1	1	1
51	21	0	0	1	0	0	1	0	1	1	1	1	1
52	26	1	1	1	1	1	1	1	1	1	1	1	1
53	19	0	0	1	0	0	1	0	1	1	0	1	1
54	22	0	0	1	0	0	1	0	1	1	0	1	1
55	27	1	1	1	0	1	1	1	1	1	1	1	1

No	Age	Walk and Turn Test Managed test: Y=1/N=0			One Leg Stand Test Managed test: Y=1/N=0			Finger-Nose Test Managed test: Y=1/N=0			Romberg Test Managed test: Y=1/N=0		
		FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{ntl} tests
56	31	0	1	1	0	0	1	0	1	1	1	1	1
57	29	0	0	1	0	0	1	0	1	1	0	1	1
58	31	0	1	1	0	0	1	0	1	1	1	1	1
59	24	1	1	1	1	1	1	1	1	1	1	1	1
60	37	1	1	1	0	1	1	0	1	1	1	1	1
61	19	0	0	0	0	0	1	0	1	1	0	1	1
62	18	0	0	1	0	0	1	0	1	1	0	1	1
63	25	1	1	1	1	1	1	1	1	1	1	1	1
64	19	0	0	1	0	0	1	0	1	1	1	1	1
65	22	0	1	1	0	0	1	0	1	1	1	1	1
66	29	1	1	1	0	1	1	1	1	1	1	1	1
67	30	0	1	1	0	0	1	0	1	1	1	1	1
68	33	0	0	1	0	0	1	0	1	1	1	1	1
69	20	0	0	1	0	0	1	0	1	1	1	1	1
70	27	0	1	1	0	0	1	0	1	1	1	1	1
71	36	0	0	1	0	0	1	0	1	1	0	1	1
72	31	1	1	1	1	1	1	1	1	1	1	1	1
73	27	0	0	1	0	0	1	0	1	1	1	1	1
74	29	1	1	1	1	1	1	0	1	1	1	1	1
75	33	0	0	1	0	0	1	0	1	1	1	1	1
76	34	0	1	1	0	0	1	0	1	1	1	1	1
77	25	0	0	1	0	0	1	0	1	1	1	1	1
78	22	0	0	0	0	0	0	0	0	1	0	1	1
79	28	1	1	1	1	1	1	1	1	1	1	1	1
80	19	0	0	1	0	0	1	0	1	1	1	1	1
81	18	0	0	0	0	0	0	0	0	1	0	0	1
82	29	0	0	1	0	0	1	0	1	1	1	1	1
83	26	0	0	1	0	0	1	0	1	1	1	1	1
84	30	1	1	1	0	1	1	1	1	1	1	1	1
85	25	0	0	1	0	0	1	0	1	1	1	1	1
86	31	1	1	1	0	1	1	0	1	1	1	1	1
87	25	0	0	1	0	0	1	0	1	1	1	1	1
88	38	0	1	1	1	1	1	1	1	1	1	1	1
89	31	0	0	1	0	0	1	0	1	1	1	1	1
90	27	0	0	1	0	0	1	0	1	1	1	1	1
91	36	1	1	1	1	1	1	1	1	1	1	1	1
92	27	0	0	1	0	0	1	0	1	1	1	1	1
93	22	0	0	1	0	0	1	0	1	1	1	1	1
94	21	0	0	0	0	0	0	0	0	1	0	1	1
95	29	1	1	1	1	1	1	1	1	1	1	1	1
96	33	0	1	1	0	1	1	0	1	1	1	1	1
97	37	0	0	1	0	0	1	0	1	1	1	1	1
98	19	0	0	1	0	0	1	0	1	1	1	1	1
99	22	0	0	1	0	0	1	0	1	1	1	1	1
10	37	0	0	1	0	0	1	0	1	1	1	1	1

APPENDIX G. RESULTS OF RESEARCH GROUP B (Methadone).

		Walk and Turn Test			One Leg Stand Test			Finger - Nose Test			Romberg Test		
		FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{n} test	FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test
No	**Age**	**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**		
1	31	0	1	1	0	1	1	1	1	1	1	1	1
2	47	1	1	1	1	1	1	1	1	1	1	1	1
3	39	1	1	1	1	1	1	1	1	1	1	1	1
4	26	1	1	1	1	1	1	1	1	1	1	1	1
5	24	1	1	1	1	1	1	1	1	1	1	1	1
6	31	0	0	1	0	0	1	0	1	1	1	1	1
7	41	1	1	1	1	1	1	1	1	1	1	1	1
8	27	1	1	1	1	1	1	1	1	1	1	1	1
9	29	1	1	1	1	1	1	1	1	1	1	1	1
10	38	1	1	1	1	1	1	1	1	1	1	1	1
11	33	1	1	1	1	1	1	1	1	1	1	1	1
12	46	1	1	1	1	1	1	1	1	1	1	1	1
13	19	0	1	1	1	1	1	1	1	1	1	1	1
14	33	1	1	1	1	1	1	1	1	1	1	1	1
15	30	0	0	1	0	0	1	0	1	1	1	1	1
16	29	1	1	1	1	1	1	1	1	1	1	1	1
17	36	1	1	1	1	1	1	1	1	1	1	1	1
18	22	0	0	0	0	0	0	0	1	1	0	1	1
19	32	1	1	1	1	1	1	1	1	1	1	1	1
20	27	1	1	1	1	1	1	1	1	1	1	1	1
21	31	1	1	1	1	1	1	1	1	1	1	1	1
22	19	0	1	1	0	1	1	1	1	1	1	1	1
23	26	1	1	1	1	1	1	1	1	1	1	1	1
24	42	0	1	1	0	1	1	1	1	1	1	1	1
25	29	1	1	1	1	1	1	1	1	1	1	1	1
26	22	1	1	1	1	1	1	1	1	1	1	1	1
27	31	1	1	1	1	1	1	1	1	1	1	1	1
28	27	1	1	1	1	1	1	1	1	1	1	1	1
29	21	1	1	1	1	1	1	1	1	1	1	1	1
30	31	1	1	1	1	1	1	1	1	1	0	1	1
31	36	1	1	1	1	1	1	1	1	1	1	1	1
32	49	0	0	1	0	0	1	0	1	1	1	1	1
33	42	1	1	1	1	1	1	1	1	1	0	1	1
34	30	1	1	1	1	1	1	1	1	1	1	1	1
35	29	0	1	1	0	1	1	1	1	1	1	1	1
36	22	1	1	1	1	1	1	1	1	1	1	1	1
37	29	1	1	1	1	1	1	1	1	1	1	1	1
38	37	1	1	1	1	1	1	1	1	1	1	1	1
39	32	1	1	1	1	1	1	1	1	1	1	1	1
40	38	1	1	1	1	1	1	1	1	1	1	1	1
41	42	0	1	1	1	1	1	1	1	1	1	1	1
42	39	1	1	1	1	1	1	1	1	1	1	1	1
43	19	1	1	1	1	1	1	1	1	1	1	1	1
44	22	1	1	1	1	1	1	1	1	1	1	1	1
45	36	1	1	1	1	1	1	1	1	1	1	1	1
46	29	1	1	1	1	1	1	1	1	1	1	1	1
47	20	1	1	1	1	1	1	1	1	1	1	1	1
48	32	1	1	1	1	1	1	1	1	1	1	1	1
49	19	0	1	1	0	1	1	1	1	1	1	1	1
50	26	1	1	1	1	1	1	1	1	1	1	1	1
51	35	1	1	1	1	1	1	1	1	1	1	1	1
52	24	0	0	1	0	0	0	0	1	1	1	1	1
53	21	1	1	1	1	1	1	1	1	1	1	1	1
54	27	1	1	1	1	1	1	1	1	1	1	1	1
55	33	1	1	1	0	1	1	1	1	1	1	1	1

		Walk and Turn Test			One Leg Stand Test			Finger - Nose Test			Romberg Test		
		FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus clues	Conv^{ntl} tests	FIT	FIT minus	Conv^{ntl} tests
No	**Age**	**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**		
56	38	1	1	1	0	1	1	1	1	1	1	1	1
57	27	1	1	1	1	1	1	1	1	1	1	1	1
58	34	1	1	1	1	1	1	1	1	1	1	1	1
59	44	1	1	1	1	1	1	1	1	1	1	1	1
60	27	1	1	1	1	1	1	1	1	1	1	1	1
61	21	1	1	1	1	1	1	1	1	1	1	1	1
62	31	0	0	0	0	0	0	0	1	1	0	1	1
63	19	1	1	1	1	1	1	1	1	1	1	1	1
64	38	1	1	1	1	1	1	1	1	1	1	1	1
65	22	1	1	1	1	1	1	1	1	1	1	1	1
66	29	1	1	1	1	1	1	1	1	1	1	1	1
67	46	1	1	1	1	1	1	1	1	1	1	1	1
68	35	0	1	1	1	1	1	1	1	1	1	1	1
69	32	1	1	1	1	1	1	1	1	1	1	1	1
70	18	0	0	1	0	0	1	0	1	1	1	1	1
71	29	1	1	1	1	1	1	1	1	1	1	1	1
72	25	1	1	1	1	1	1	1	1	1	1	1	1
73	33	1	1	1	1	1	1	1	1	1	1	1	1
74	46	0	1	1	0	1	1	1	1	1	1	1	1
75	28	1	1	1	1	1	1	1	1	1	1	1	1
76	31	1	1	1	1	1	1	1	1	1	1	1	1
77	20	1	1	1	1	1	1	1	1	1	1	1	1
78	35	1	1	1	1	1	1	1	1	1	1	1	1
79	32	0	1	1	0	1	1	1	1	1	1	1	1
80	41	1	1	1	1	1	1	1	1	1	1	1	1
81	34	1	1	1	1	1	1	1	1	1	1	1	1
82	37	0	0	1	0	0	1	0	1	1	1	1	1
83	25	1	1	1	1	1	1	1	1	1	1	1	1
84	45	1	1	1	1	1	1	1	1	1	1	1	1
85	26	1	1	1	1	1	1	1	1	1	1	1	1
86	33	1	1	1	1	1	1	1	1	1	1	1	1
87	29	0	1	1	0	0	1	0	1	1	1	1	1
88	19	1	1	1	1	1	1	1	1	1	1	1	1
89	23	1	1	1	1	1	1	1	1	1	1	1	1
90	39	1	1	1	1	1	1	1	1	1	1	1	1
91	42	1	1	1	1	1	1	1	1	1	1	1	1
92	20	1	1	1	1	1	1	1	1	1	0	1	1
93	31	1	1	1	1	1	1	1	1	1	1	1	1
94	39	0	1	1	0	1	1	1	1	1	1	1	1
95	33	1	1	1	1	1	1	1	1	1	1	1	1
96	18	1	1	1	1	1	1	1	1	1	1	1	1
97	40	0	1	1	0	1	1	1	1	1	1	1	1
98	22	1	1	1	1	1	1	1	1	1	1	1	1
99	29	1	1	1	1	1	1	1	1	1	1	1	1
10	36	1	1	1	1	1	1	1	1	1	1	1	1

APPENDIX H. RESULTS OF RESEARCH GROUP C ("Controls").

		Walk and Turn Test			One Leg Stand Test			Finger - Nose Test			Romberg Test		
		FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test
No	**Age**	**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**		
1	29	1	1	1	1	1	1	1	1	1	1	1	1
2	27	1	1	1	1	1	1	1	1	1	1	1	1
3	36	0	1	1	0	1	1	1	1	1	1	1	1
4	33	1	1	1	1	1	1	1	1	1	1	1	1
5	29	1	1	1	1	1	1	0	1	1	1	1	1
6	32	0	1	1	0	1	1	1	1	1	1	1	1
7	29	0	0	1	0	0	1	0	1	1	1	1	1
8	36	1	1	1	1	1	1	1	1	1	1	1	1
9	30	0	1	1	0	0	1	1	1	1	1	1	1
10	28	1	1	1	1	1	1	1	1	1	1	1	1
11	35	1	1	1	1	1	1	1	1	1	1	1	1
12	29	1	1	1	1	1	1	1	1	1	1	1	1
13	32	1	1	1	0	1	1	1	1	1	1	1	1
14	37	0	1	1	0	1	1	1	1	1	1	1	1
15	32	1	1	1	1	1	1	1	1	1	1	1	1
16	34	0	1	1	0	0	1	1	1	1	1	1	1
17	28	0	1	1	0	1	1	1	1	1	1	1	1
18	35	1	1	1	1	1	1	1	1	1	1	1	1
19	28	1	1	1	1	1	1	1	1	1	1	1	1
20	29	0	0	1	0	0	1	0	1	1	0	1	1
21	39	1	1	1	1	1	1	1	1	1	1	1	1
22	27	1	1	1	1	1	1	1	1	1	1	1	1
23	28	1	1	1	1	1	1	1	1	1	1	1	1
24	36	1	1	1	0	1	1	1	1	1	1	1	1
25	30	0	1	1	0	1	1	1	1	1	1	1	1
26	33	1	1	1	1	1	1	1	1	1	1	1	1
27	34	1	1	1	1	1	1	1	1	1	1	1	1
28	28	0	1	1	0	1	1	1	1	1	1	1	1
29	33	0	0	1	0	0	1	1	1	1	1	1	1
30	27	0	1	1	0	1	1	1	1	1	1	1	1
31	35	1	1	1	1	1	1	1	1	1	1	1	1
32	31	1	1	1	0	1	1	1	1	1	1	1	1
33	29	1	1	1	1	1	1	1	1	1	0	1	1
34	30	0	0	0	0	0	0	0	1	1	0	1	1
35	33	1	1	1	1	1	1	1	1	1	1	1	1
36	27	1	1	1	1	1	1	1	1	1	1	1	1
37	34	0	0	1	0	0	1	0	1	1	1	1	1
38	42	1	1	1	0	0	1	1	1	1	1	1	1
39	27	1	1	1	1	1	1	1	1	1	1	1	1
40	25	0	1	1	0	1	1	1	1	1	1	1	1
41	30	1	1	1	1	1	1	1	1	1	1	1	1
42	28	0	1	1	0	1	1	1	1	1	1	1	1
43	33	1	1	1	1	1	1	1	1	1	1	1	1
44	31	1	1	1	1	1	1	1	1	1	1	1	1
45	27	0	1	1	0	0	1	1	1	1	0	0	1
46	30	1	1	1	1	1	1	1	1	1	1	1	1
47	39	1	1	1	1	1	1	1	1	1	1	1	1
48	29	0	0	1	0	0	1	0	1	1	0	1	1
49	34	1	1	1	1	1	1	1	1	1	1	1	1
50	28	1	1	1	1	1	1	1	1	1	1	1	1
51	30	0	1	1	0	1	1	1	1	1	1	1	1
52	28	1	1	1	1	1	1	1	1	1	1	1	1
53	36	1	1	1	1	1	1	1	1	1	1	1	1
54	32	0	1	1	0	1	1	1	1	1	1	1	1
55	39	1	1	1	0	1	1	1	1	1	1	1	1

		Walk and Turn Test			One Leg Stand Test			Finger - Nose Test			Romberg Test		
		FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test	FIT	FIT minus clues	Conv^{ntl} test
No	**Age**	**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**			**Managed test: Y=1/N=0**		
56	31	0	0	1	0	0	1	0	1	1	1	1	1
57	38	1	1	1	0	1	1	1	1	1	1	1	1
58	29	1	1	1	1	1	1	1	1	1	1	1	1
59	41	1	1	1	1	1	1	1	1	1	1	1	1
60	29	0	0	1	0	0	1	0	1	1	0	1	1
61	37	1	1	1	1	1	1	1	1	1	1	1	1
62	31	0	1	1	0	1	1	1	1	1	1	1	1
63	32	1	1	1	1	1	1	1	1	1	1	1	1
64	34	1	1	1	1	1	1	1	1	1	1	1	1
65	31	0	0	1	0	0	1	0	1	1	0	1	1
66	29	0	1	1	0	1	1	1	1	1	1	1	1
67	31	1	1	1	1	1	1	1	1	1	1	1	1
68	35	1	1	1	1	1	1	1	1	1	1	1	1
69	34	1	1	1	0	1	1	1	1	1	1	1	1
70	31	0	1	1	0	1	1	1	1	1	1	1	1
71	29	1	1	1	1	1	1	1	1	1	1	1	1
72	30	1	1	1	1	1	1	1	1	1	1	1	1
73	38	1	1	1	1	1	1	1	1	1	1	1	1
74	29	0	0	1	0	0	1	0	1	1	1	1	1
75	33	1	1	1	1	1	1	1	1	1	1	1	1
76	36	1	1	1	1	1	1	1	1	1	1	1	1
77	32	0	1	1	0	1	1	1	1	1	1	1	1
78	38	1	1	1	1	1	1	1	1	1	1	1	1
79	31	0	1	1	0	1	1	1	1	1	1	1	1
80	33	0	1	1	0	1	1	1	1	1	1	1	1
81	30	1	1	1	1	1	1	1	1	1	1	1	1
82	28	1	1	1	1	1	1	1	1	1	1	1	1
83	38	0	0	1	0	0	1	0	1	1	1	1	1
84	36	1	1	1	1	1	1	1	1	1	1	1	1
85	34	0	1	1	0	1	1	1	1	1	1	1	1
86	37	1	1	1	1	1	1	1	1	1	1	1	1
87	30	0	1	1	0	1	1	1	1	1	1	1	1
88	42	1	1	1	1	1	1	1	1	1	1	1	1
89	28	1	1	1	1	1	1	1	1	1	1	1	1
90	38	1	1	1	1	1	1	1	1	1	1	1	1
91	33	0	1	1	0	1	1	0	1	1	0	1	1
92	36	1	1	1	0	1	1	1	1	1	1	1	1
93	32	1	1	1	1	1	1	1	1	1	1	1	1
94	38	1	1	1	1	1	1	1	1	1	1	1	1
95	41	0	0	0	0	0	0	0	1	1	0	1	1
96	33	0	1	1	0	1	1	1	1	1	1	1	1
97	37	1	1	1	1	1	1	1	1	1	1	1	1
98	46	0	1	1	0	0	1	1	1	1	1	1	1
99	35	1	1	1	1	1	1	1	1	1	1	1	1
10	28	1	1	1	1	1	1	1	1	1	1	1	1

APPENDIX I.

PRESENTATIONS & PUBLICATIONS IN SUPPORT OF THIS THESIS.

(1) O'Keefe, M. (2001). Drugs driving – standardized field sobriety tests: a survey of police surgeons in Strathclyde. *Journal of Clinical Forensic Medicine.* 8. 57-65.

(2) O'Keefe, M. (2003). "A study of the perceptions and opinions of practising police surgeons with regard to Drug Driving and Standardised Field Sobriety Tests / FIT." IN. 30th Annual Conference of the Association of Police Surgeons of Great Britain. 15-20 May 2003. Brighton. U.K.

(3) O'Keefe, M. (2004). "Field Impairment Tests – A survey of members of the Association of Forensic Physicians." IN. T2004. International Conference on Alcohol Drugs and Traffic Safety. (ICADTS). 8-13 August Glasgow 2004. Glasgow. U.K.

(4) O'Keefe, M. (2007). "Field Impairment Tests – A Forensic Physician's Viewpoint." IN. T2007 Joint meeting of - The International Association of Forensic Toxicologists (TIAFT) and The International Council on Alcohol Drugs and Traffic Safety (ICADTS). 26-30 August 2007. Seattle, Washington, U.S.A.